ATIONAL EDITION

ANUARY
1948

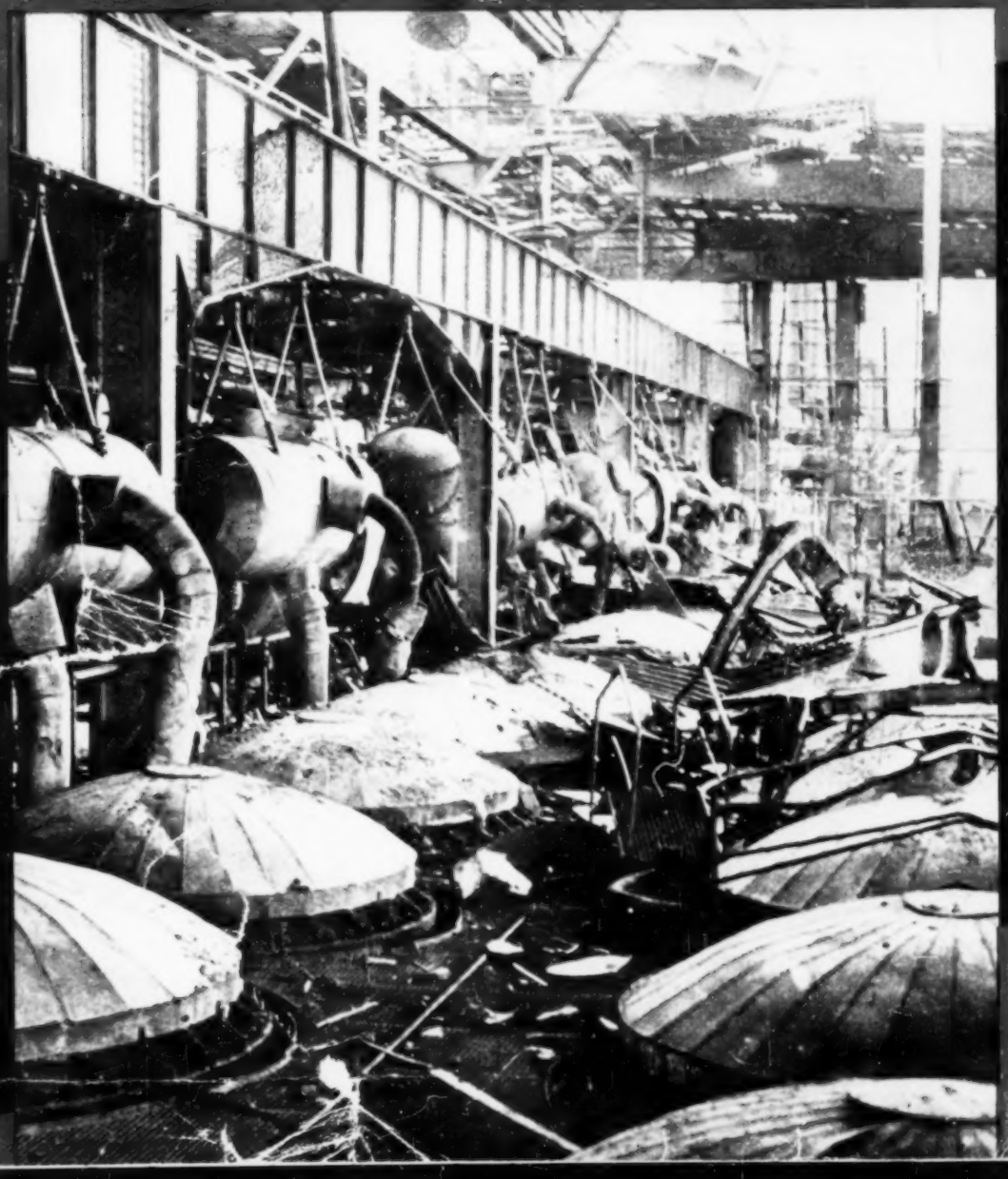
CHEMICAL ENGINEERING

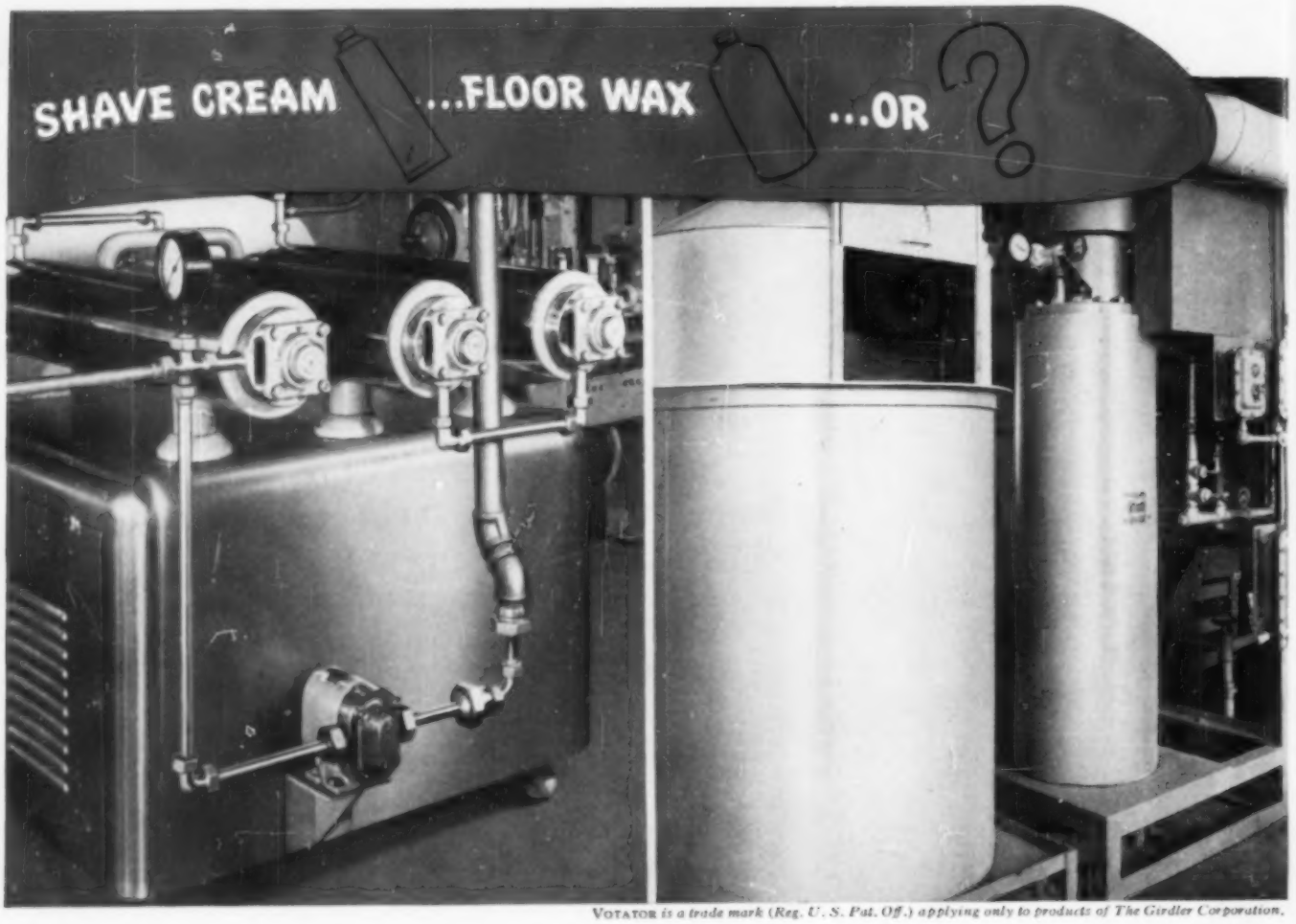
WITH CHEMICAL & METALLURGICAL ENGINEERING

his issue features: disposal
fabulous I. G. Farben;
ocess control with radio-
ctivity; peroxide helps
odernize de-inking mill;
ast, present and future of
ethanol; ammonia gets a
b as fertilizer; resistant
ning for alum making
uipment; simplified ap-
oach to mixing; depreciа-
on.

*over Picture: One of the I. G.
rben units to be disposed of
the Fischer Tropsch plant.*

McGRAW-HILL PUBLICATION





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CHEMICAL ENGINEERING

with CHEMICAL & METALLURGICAL ENGINEERING

Volume 55 Number 1

JANUARY 1948

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Contents

THIS MONTH

Chemical Engineering Fundamentals 97
EDITORIAL FOREWORD

Fabulous I. G. Farben Disintegrates 98
By JOHN J. CHRISTIE

Chemical Process Control With Radioactivity 103
By ALAN P. SCHREIBER

Paper Mill Goes Modern—Now De-Inks With Peroxide 106
By JAMES A. LEE

Methanol Industry Makes Plans for the Future 110
By ANTHONY A. WILLIAMS

Down on the Farm Ammonia Gets a New Chore 114

Process Engineer's Guide to the Centrifugal Compressor—IV 118
By IGOR J. KARASSIK

Short-Cut Estimation of Welded Process Vessels 122
By HARLAN HOW

Simplified Approach to Mixing Problems 127
By H. E. SERNER

Good Old Depreciation 130
By W. I. McNEILL

As Merck Received Ch. E. Award 131

Heat Transfer Symposium 134

Water Supply 137
A "CHEM & MET" REPORT

De-Inking Mill 146
A "CHEM & MET" PICTURED FLOWSHEET

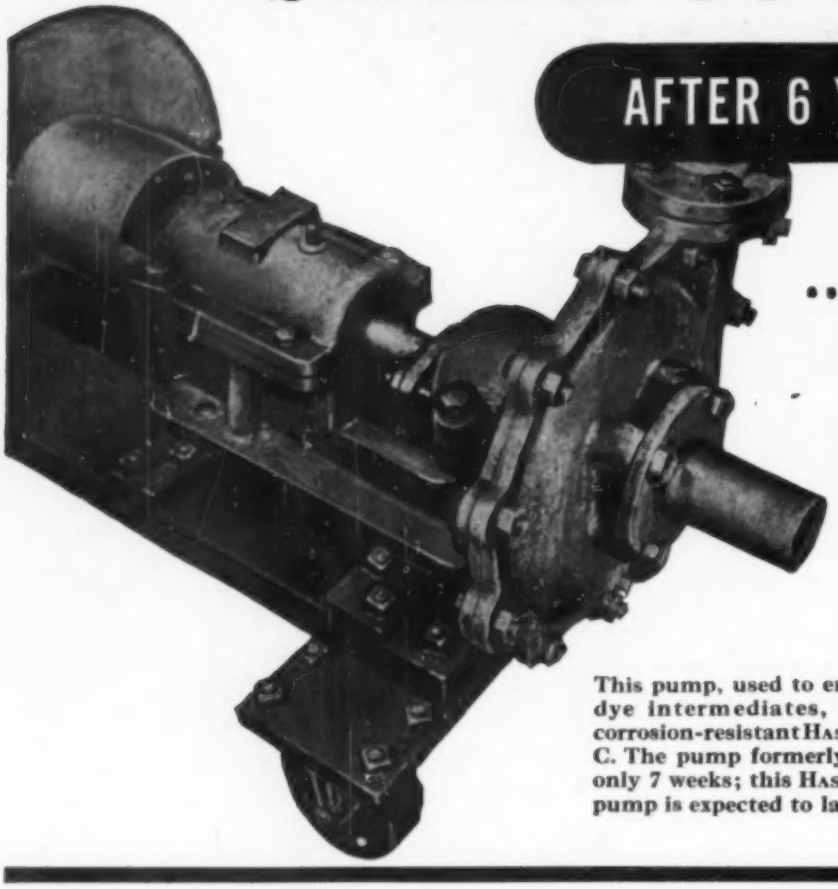
Sodium Chloride vs. Materials of Construction—Part IV 223
A SYMPOSIUM

EVERY MONTH

The Chementator 73
Editorial Foreword 97
The Plant Notebook 135
"Chem & Met" Report 137
Pictured Flowsheet 146
Process Equipment News 153
Manufacturers' Publications 169
Reader Service Coupons 170
New Products and Materials 173
Chemical Engineering News 185
Convention Calendar 188
News From Abroad 207
The Corrosion Forum 223
From the Log of Experience 237
Names in the News 241
Industrial Notes 250
Convention Paper Abstracts 256
Foreign Literature Abstracts 280
Chemical Engineer's Bookshelf 287
Government Publications 304
Chemical Economics 313
Production and Consumption Trends 316
U. S. Production of Chemicals 318
Current Prices 322
New Construction 326

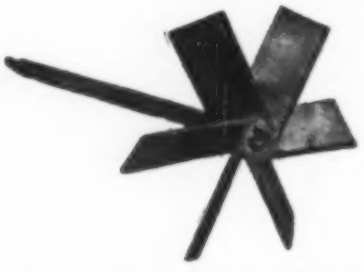
STILL in GOOD SHAPE-

AFTER 6 YEARS OF SERVICE



...HASTELLOY Alloy C Parts Resist Corrosive Action of Dye Intermediates

This pump, used to empty vats of dye intermediates, is made of corrosion-resistant HASTELLOY alloy C. The pump formerly used lasted only 7 weeks; this HASTELLOY alloy pump is expected to last 10 years.



HASTELLOY alloy C agitator shaft and blades are used in a reaction vat. Whip and unbalance in the agitated fluid often places considerable stress on the shaft; high-strength HASTELLOY alloy is not affected by this stress.

This steam jet of cast HASTELLOY alloy C is also used in a reaction vat. After 6 years service in acids, alkalies, and strong oxidizing agents, the jet is still in good operating condition.

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THE
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COMMENTS ON THE NEWS OF CHEMICAL ENGINEERING IN INDUSTRY

Volume 55 JANUARY · 1948 Number 1

Chemical production hit a new peak in 1947. Dollar value of chemicals and allied products was about $9 billion. Unparalleled peacetime demand, both domestic and foreign, resulted in expansion of chemical plant capacity in the United States and permitted the sharp upturn in output. Exports in 1947 probably exceeded $750 million. But price increases accounted for more than 10 percent of the dollar value of production and exports. Expansion of plant capacity since 1939 has added $2.4 billion to an estimated $3 billion of productive facilities in 1939. This does not include plants built only for military use. Fertilizers provided the largest single outlet for chemicals. Paint industry, for the first time in its history, went over $1 billion.

Outlook for 1948 is that the chemical process industries, entering the new year on a level about 5 percent higher than they did last January, will continue, or surpass, their record-shattering performance through the first quarter and possibly the first half. Thereafter the pattern of 1947 will be followed closely.

•

Elemental phosphorus production in the electric furnace, hailed as a forward-looking step when first undertaken some years ago, now underlies an important segment of chemical industry. On the West Coast a call has been made for an expenditure of $35 million to construct electric furnace plants in the Columbia Basin. This would integrate the phosphorus and phosphate fertilizer industry of the Pacific Northwest. Another late development is Westvaco's plan to build an electric furnace plant near Pocatello, Idaho (p. 185).

•

Recovery of byproduct hydrochloric acid is adding to the supply as hydrocarbon chlorinating operations increase. This is something for old-line heavy chemicals makers to ponder. Output of hydrochloric topped 400,000 tons in 1947. This was an increase of nearly 70,000 tons over 1946. Much of this increase came from stepped-up chlorinating operations. In its $1,060,000 plant at Memphis, Tenn., purchased from WAA, Heyden is now chlorinating benzene. Its byproduct acid is for sale. Likewise chlorinating benzene and recovering hydrochloric is Glyco at its Natrium, W. Va., plant, a former CWS installation.

•

Future synthetic ammonia plant locations will have to be chosen with a view to securing long-term supplies of cheap natural gas. Natural gas prices have increased from 2 or 3 c. per 1,000 cu. ft. a few years ago to 5 c. at the well. One plant is threatened with 30-c. gas under a new contract. Price advances result from upsurge in demand, not shrinkage of underground reserves. Best estimates of proved reserves run to 160 trillion cubic feet. Discovery has outrun use. But demand is now alarmingly ahead of production from present wells. It is now obviously cheaper to move ammonia by tank car from a remote synthesis plant than it is to move the gas to the area of nitrogen fertilizer consumption. This does a lot to fix prospective plant locations.

•

If demand stays high, fertilizer industry can produce 20 million tons a year by 1950. Output for 1947, 16.5 million tons, was 14 percent above 1946, the year of the previous all-time record.

Total exports of fertilizer already committed for the 1947-48 year amount to 28 percent of total United States supply of fertilizer nitrogen, compared with 18 percent shipped out of this country in 1946-47.

•

Direct application of ammonia to crops may provide ammonia producers with an important market. At 6 c. per lb. of nitrogen, anhydrous ammonia is the cheapest source of fertilizer nitrogen (p. 114).

•

Potash output will climb another 10 percent this year. Producers have promised this. Last year potash production topped the previous record year by 10 percent. Technical improvements in the refinery operations at Carlsbad, N. M., account for part of this steady advance in efficiency. Still newer techniques just being built into these refineries will add to recovery of K_2O from potash minerals hoisted. Domestic sources supplied over a million tons of fertilizer K_2O last year. This is a thirty-fold increase in 15 years.

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PLASTICS & SYNTHETICS DIVISION

U. S. STONEWARE

Akron 9, Ohio

Union Carbide & Carbon has borrowed $150 million from three insurance companies on promissory notes bearing 2.7 percent interest and maturing in 20 years. Proceeds will further Union Carbide's expansion program that got $90 million last year and $50 million in 1946.

•

Du Pont has announced cuts of from 4 to 7 c. a lb. in polythene prices. This is the fifth reduction since polythene manufacture started in 1943. Uncompounded molding powder without coloring formerly sold for 50 c. a lb. Earlier, Bakelite had lowered polyethylene prices in a reduction also ranging from 4 to 7 c. a lb. Increased production and use of polyethylene plastics, Bakelite reported, made the cut possible.

•

Rayon producers, except possibly government-controlled North American Enka and Bemberg, will probably follow Du Pont in its price advances of more than 10 percent on filament yarn and staple fiber.

Acetate prices have been increased by about 7 c. a lb. on all sizes. Viscose staple has been raised approximately 3 c. a lb. on all sizes. Viscose filament price increases on 75-, 100- and 150-denier sizes are respectively 15 c., 10 c. and 5 c. a lb.

•

Hydroabietyl alcohol, first commercially available primary alcohol from rosin, will undersell fatty alcohols. It sells at 20 c. a lb. in tank cars and 25 c. a lb. in small lots. Fatty alcohols range from 40 to 45 c. a lb. Made by Hercules in its new $3 million plant at Burlington, N. J., this low-cost alcohol from rosin will find uses in textile, rubber adhesive, detergent and paint, varnish and lacquer fields.

•

Sodium hydride is used increasingly as a condensing agent in Claisen condensations. These are condensations of esters with esters, esters with aldehydes and esters with ketones. Sodium hydride increases yields from 10 to over 100 percent. It shortens reaction times, permits closer control and improves product quality. Du Pont, principal producer, has a weather eye on sodium hydride possibilities. Ashtabula, Ohio, has been rumored as a new plant site.

Du Pont's sodium hydride descaling process permits quick and positive removal of oxide scale from metal surfaces. Sodium hydride, produced on the spot by reacting sodium with hydrogen, reduces oxide scale to metal or lower metallic oxide, simultaneously forming caustic soda. The process is non-electrolytic. Any metal or alloy that does not react with molten caustic can be descaled. The working temperature of 700 deg. F. is well below the critical temperature of most alloys and steels.

Supercold is a new tool. Using liquid helium, temperatures can be obtained within a few degrees of absolute zero. In this region, matter exhibits remarkable properties. Navy investigators, among others, are studying electrical and magnetic phenomena at "supercold" temperatures.

•

Design of production units for a new antibiotic may give biochemical engineers their next challenging job. Chloromycetin is the first antibiotic effective against organisms producing typhus. It is also the first substance to show activity against a virus. This it has done in its action against psittacosis, or parrot fever. Experimental results remain to be corroborated in larger animals and humans. Derived from a mold related to the species producing streptomycin, this new antibiotic may be the weapon to overcome typhus, major scourge of man.

The mold was isolated in a Yale laboratory and the crystalline chloromycetin was obtained in research laboratories of Parke, Davis & Co. Tests with mice and chick eggs were conducted at the Army Medical Center.

•

Chemical Corps seeks to determine what groupings, radicals or linkages within gas molecules are responsible for toxicity. This research, similar to the dye industry's hunt for chromophores, will be pushed in fiscal 1949.

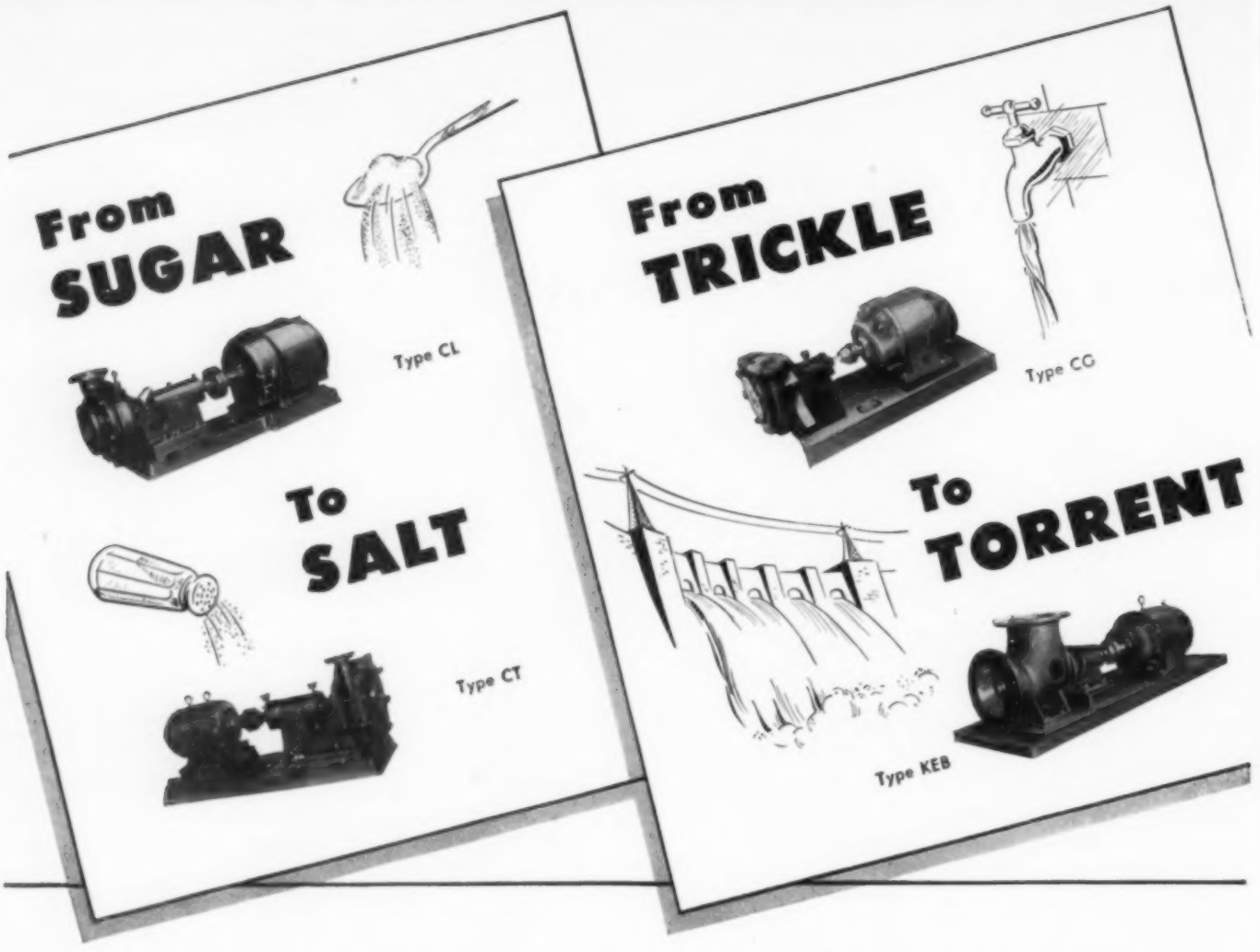
•

Radioactive isotope of carbon is used by Gulf Research & Development Corp. to find out the function of the iron catalyst used in the Fischer-Tropsch process for making hydrocarbons from natural gas and coal. Theory is that carbon monoxide forms an iron carbonate which then reacts with the hydrogen. To test this, Gulf researchers use radio-carbon to form a carbonate on the surface of the catalyst. If the theory is correct, the oil coming out ought to be radioactive. AEC supplies the isotope.

•

Geneva Agreement is a delayed-action bomb. When it goes off, chemicals makers will be among the casualties of foreign competition. But it will not go off for some time. Low production abroad will continue. United States imports of chemicals will remain a trickle, soaked up by high demand. Dollar shortages in foreign countries spell import quotas and exchange controls. Thus United States exports of chemicals will be limited. But when foreign competitors solve their currency and production problems they will enter the United States markets. The Geneva Agreement will give them a big advantage. And labor costs abroad are low. The bomb will go off.

For a preview of what is inside the bomb, look carefully into Schedule XX of the Geneva Agreement.



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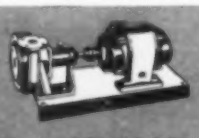

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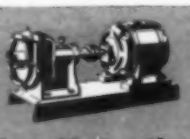
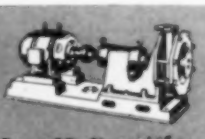
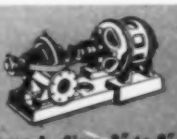


Type CF. Sizes 1" to 4". Capacities to 1000 GPM; heads to 130 ft. Standard, all iron and all bronze.



Type CQ. Sizes 1½" to 3". Capacities to 600 GPM; heads to 130 ft. at 1750 RPM. Closed impeller. WORTHITE shaft and fittings.



Type L. Sizes 3" to 8". Capacities to 2250 GPM; heads to 300 ft. Single stage volute. For general service.

Here's my New Year's resolution

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Its 206 pages are packed with high explosive. It discloses downward revisions of every major section of the tariff law. These revisions are designed to stimulate substantially the import of chemical products when import offerings are again available. Equally important to chemical industry are concessions made on finished goods such as textiles, rayon, glass and ceramics. Concessions represent an over-all reduction in tariffs of about 50 percent from 1930 rates.

Most concessions on chemicals granted by participating countries merely bind existing rates. Clearly, these grants only slightly offset United States concessions.

•

Vigorous efforts will be made to let the Reciprocal Trade Agreement Act die upon its expiration in June 1948. Administration will ask for its extension as a mainstay of foreign policy. Congress will probably agree to extend the act another year. It may attach such strings as a requirement for Congressional approval of agreements or a 90-day waiting period. During the waiting period Congress would act, or permit such agreements to become effective by inaction within the time-limit.

Important to American industry in connection with future competition from imports will be a revival of flexible provisions (Sec. 336), with the right to act on items on which a reduction has been made. At present, no action can be taken under Sec. 336 with respect to any product that is the subject of a trade agreement.

•

Controls on distribution and export of certain vital chemical products are certain. Congress will decide whether voluntary or official, and at what level. Most likely to be controlled tightly are nitrogen chemicals for fertilizer.

•

Expected conversion of ammonia synthesis capacity to methanol making is going to be postponed. Need for ammonia to manufacture fertilizers is the reason. Formaldehyde producers and anti-freeze distributors will feel the pinch through 1948-49. And no one knows yet how far Congress or executive departments will go in grabbing ammonia, either to meet international relief requests or for Armies of Occupation. Even explosive ammonium nitrate is being snatched up for fertilizer use. Nitrogen-hungry industry is hard to scare.

•

Interior Department's Max Ball sees expansion of oil output from the Middle East as best bet to ease the oil shortage. Oil from abroad would supplement domestic supply. Domestic oil wells are an ace in the hole for an emergency. This country has only 31 percent of the world's known oil reserves, but it produces 63 percent of the world's consumption. United States per capita use of petroleum products has risen from 367 gal. in 1938 to 608 gal. in 1947. Ball does not expect significant production of synthetic fuels within the next ten years.

•

To wait until an emergency to build synthetic liquid fuel plants might be dangerous. Strongest advocate of this view is W. C. Schroeder, chief of the Office of Liquid Fuels of the Bureau of Mines. To build a capacity of from 1 to 2 million barrels of synthetic liquid fuel daily would require several years, large amounts of steel and manpower. Such a program would be five to ten times the magnitude of the wartime synthetic rubber development.

Synthetic liquid fuel plants would augment present petroleum resources. Before the war this country had a cushion of about 1 million barrels of crude oil a day that could be drawn on for war purposes. Now domestic production is barely enough to meet needs. Demand is rising.

Cost of synthetic fuels at the plant will be from 3 to 5 c. a gal. higher than present prices of petroleum products. But process improvement and large-scale operation can narrow this gap.

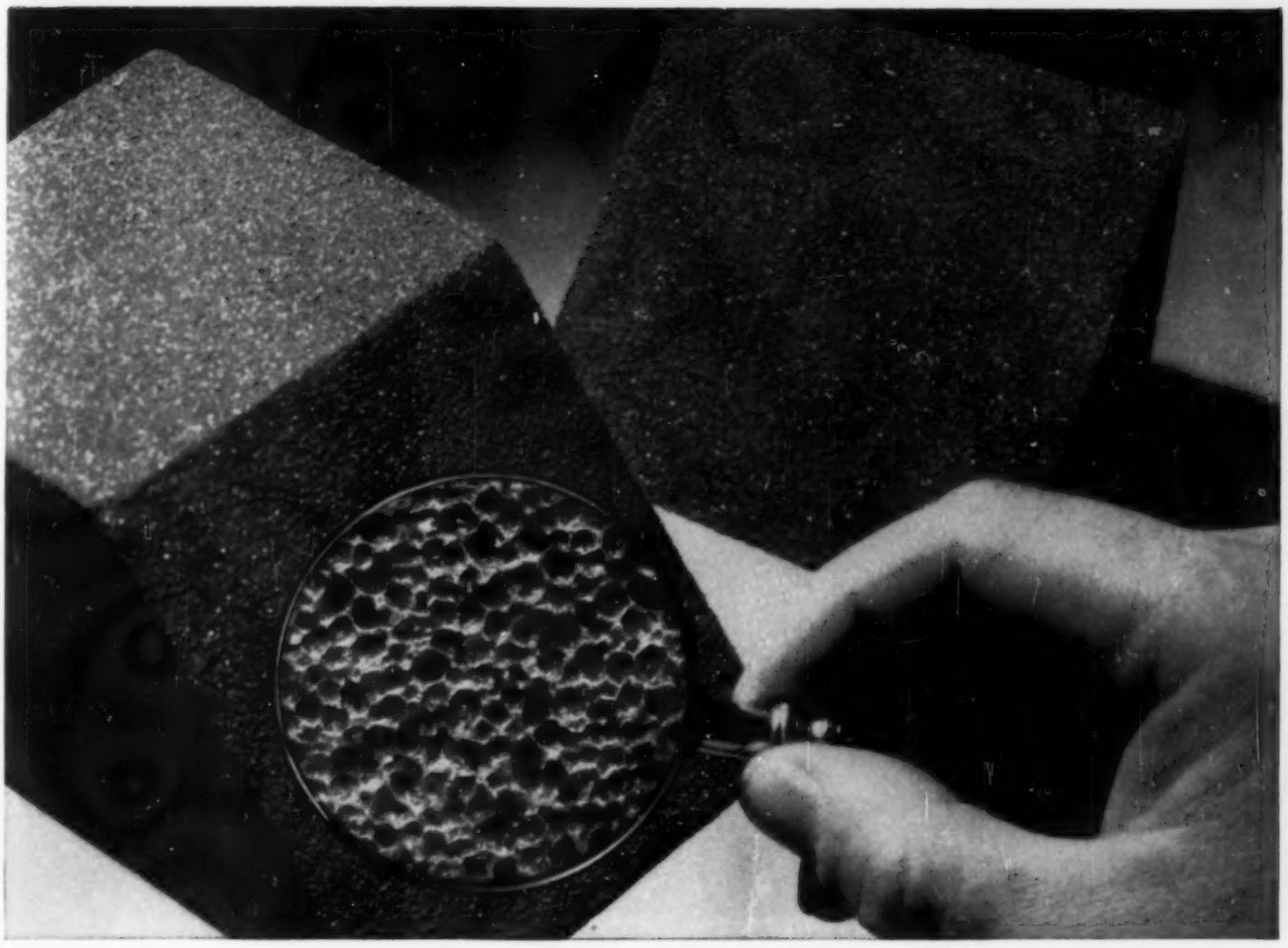
•

Meeting of civilian and military magnesium experts in Washington recently underlines anxiety of military men over imminent shut-down of the nation's only plant producing magnesium. The military, with a wary eye on security, want the plant kept running. But the over-supply of magnesium, which precipitated the conference, stares them in the face. From a wartime peak of 400 million pounds consumption of magnesium has dropped to 36 million pounds in 1947. There is, moreover, a civilian stockpile of about 100 million pounds. Civilian uses, although varied, involve small tonnages.

•

Hearings held by a House Armed Services subcommittee, headed by Representative Paul W. Shafer, Michigan Republican, foreshadow coming legislation on synthetic rubber. National security is the paramount consideration. Government stockpiling of natural rubber will continue.

Unless extended by Congress, the Administration's wartime controls over rubber expire at the end of March. Controls probably will continue for another year or two. A minimum of one-third synthetic rubber in manufacture of tires, tubes and other rubber products is presently required. Eventually this requirement may be reduced to one-fourth.



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Use of synthetic rubber at substantially the current yearly level of 475,000 tons will persist. Standby capacity of 600,000 tons of general-purpose synthetic a year will be advocated. Some of the $700 million worth of government synthetic rubber plants will be sold or leased to private industry. Future-delivery and recapture clauses will be written into leases.

Research may produce a synthetic rubber equal or superior to natural rubber. Until that happens, government will support the synthetic industry. To step up research, the patent-pooling agreement of 1941 will most likely be dropped.

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More streptomycin will be made as its use in treating certain types of tuberculosis grows. New techniques at Merck's Elkton, Va., plant will increase production this year. To its sterile techniques building at Rahway, N. J., Merck is adding a new $400,000 finishing and packaging unit.

•

On the ball at last, the Army is speeding up release of ammonium nitrate plants to private industry. Opened January 15 were bids on the 60,000-ton unit at the Cactus Ordnance Works, Etter, Tex. This is one of the last three nitrate plants in Army possession. Army will stick to its leasing policy, probably advertising the remaining two plants in February.

Successful bidder for the Etter plant, now operated by Spencer Chemical, must agree to give the Army all production as long as the Army wants it. Installed capacity must also be upped to 100,000 tons annually. In an emergency, plant must revert to the Army.

Two nitrate units at the Louisiana, Mo., Ordnance Works have been appraised by WAA. Combined capacity of the units is 100 tons a day. Hercules, present operator, has first crack at the units if it wants to buy at WAA's "fair value." It has 60 days to decide after hearing the fair-value figure. If Hercules turns down the WAA offer, then WAA will advertise for bids and dispose of the plants on the open market.

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War Assets Administration has put ten Army ordnance works worth $500 million on the block. Facilities include production and processing units at one or more locations for ammonia oxidation, sulphuric acid concentration, oleum, nitric acid, sellite, solvent recovery, cotton or wood pulp nitration, finished smokeless powder, DNT, TNT, tetryl, pentalite and ammonium picrate. Plants will have to be decontaminated of explosive materials by purchasers. Bids will be received for fixed-price purchase or for cash down-payment with gross receipts from resale split equitably between purchaser and government.

Recent Supreme Court decision in the Uebersee appeal put the brakes on Justice Department plans to dispose of several major corporations held by the Alien Property Custodian, including a $60 million interest in General Aniline & Film Corp. and its $4.9 million sales agency, General Dyestuffs Corp.

The Supreme Court, in effect, ruled that before the Justice Department can dispose of plants seized from such non-belligerents as the Swedes or Swiss, it has to prove in court, if challenged, that the former owners had been "cloaking" for enemy nationals.

Almost a certainty now is a court suit for return of GAF to its Swiss owners which will hold up a government offer for perhaps several years. I. G. Chemie, the Swiss corporation, will probably file suit in a United States district court.

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Calco has landed a body blow to the dyestuffs black market. It has sharply warned its customers in the textile, leather, paper and plastics industries that it will stop selling dyes to any consumer caught reselling at fancy prices for export. Europe, which once got dyes from I. G. Farben, is now almost entirely without them. Thus dyes sold for export fetch sky-high prices. Some mills are allegedly selling to this black market.

To halt dyestuffs sales to cash buyers for export looks like a tough assignment. Such buyers do not disclose eventual destination of their purchases, so it is hard for sellers to discriminate against them.

U. S. manufacturers would send more dyes to Europe if these could be spared from domestic consumption. But spot shortages of certain dyestuffs, caused by increased consumption and scarcity of intermediates, continues. The American dyestuffs industry just has not grown large enough to fill world demand. Some day Europe will start making dyes again. American producers will then find themselves in direct competition.

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Key Navy researchers talked shop with technical men from industry in a precedent-setting two-day session recently in Washington. Members of the Navy Industrial Association met the Navy's research and development workers, learned of test equipment devised by the military and seldom duplicated in civilian laboratories, and exchanged ideas with Naval technical experts working in closely allied fields. A smart move by the topside gold braid, the meeting promises continuing contact between industry and Naval research.

CHEMICAL ENGINEERING
with CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902 JANUARY 1948 SIDNEY D. KIRKPATRICK, Editor

Chemical Engineering Fundamentals

CHALMER G. KIRKBRIDE, in the preface of his new and somewhat controversial textbook of this title, writes: "Because of the emphasis that has been placed on the unit-operation concept of chemical engineering in the past, many students have been graduated with the erroneous belief that the unit operations are themselves the fundamentals of chemical engineering, rather than mere applications of fundamental principles. A lack of appreciation of this distinction is a common cause of difficulty for the beginner in professional practice." (Parenthetically, we might note that many older practitioners suffer from the same deficiency!) "Until the practicing engineer recognizes the errors in this viewpoint and grasps the alternative philosophy of thinking in terms of real fundamentals, his progress is likely to be retarded." Whereupon the author sets out and in ten chapters pretty well proves that basic knowledge of a comparatively few underlying principles of chemistry, physics and mathematics, plus human relations and report writing, can lay the best possible foundation for a career in our profession.

We have called this book controversial only because it has aroused sharply different reactions from some of our friends in industry and in education. One reports that it is "too difficult for an introductory course," another that it is "too far advanced for sophomores and early juniors." Yet strangely enough one well-known professor holds that it's "too philosophical, too incomplete in real technical information" to find a place in his curriculum. Frankly, we are not surprised by such divisions of opinion, for we are old enough to recall the storms that brewed around certain other chemical engineering textbooks more than twenty years ago. The industrial chemistry teachers then said they were too theoretical and mathematical, while the physical chemists regarded them as too "practical"—meaning narrow and empirical. But nearly all of the critics seemed to agree that this book will help to provide better orientation and promote a more purposeful study of subsequent courses.

We started out to write an editorial—not a book review. We thought we saw in this new type of textbook a lesson for all of us in these uncertain days. We liked Kirkbride's stress on fundamentals. It is altogether too easy right now to confuse effects with causes, applications with principles. We are asked to attack inflation by attempting to control its symptoms—rising prices and wages. We are trying to help Europe by feeding breadlines when we know that they are caused by industrial and agricultural stagnation. Somehow or other we have to get at the basic causes—the real fundamentals of these problems.

Chairman Eccles, of the Federal Reserve Board, came closer to the right solution than any of the palliatives which President Truman and others have asked of the Congress. "Nothing could be more effective," he said, "than increased productivity of labor and longer hours of work by everyone." Here is the hard-headed banker talking a language that chemical engineers can understand. And do something about. We can help to hold the price line by cutting costs through increased efficiency. We can strive for greater productivity per worker, per process, per plant. Where "wage increases are imperative" (to use the words of President Truman's executive order of Oct. 20, 1947), let us make them contingent on increasing output, which is equally imperative if we are going to stop the spiral of inflation.

So, Dr. Kirkbride, the profession thank you for "Chemical Engineering Fundamentals." It comes at a time when more basic thinking is needed by all of us—as editors, students, teachers, industrialists, and American citizens.

Fabulous I. G. Farben Disintegrates

JOHN J. CHRISTIE
McGraw-Hill World News, Berlin, Germany

WHAT LIES AHEAD, ATTITUDE OF SOVIETS, MECHANICS OF DISPERSAL OF UNITS, EFFECTS OF REPARATIONS ON GERMAN PEACETIME CAPACITY

Here is an on-the-spot account of the advanced stage of dispersal of the German I. G. Farbenindustrie units. Mr. Christie discusses actions taken by the four-power Allied Control Council to dissolve the great cartel by disposing of its stock interests in some units, disposition of patents and trade marks, and liquidation of many plants. Of particular interest are the effects of reparations on peacetime capacity of the German plants in the Eastern and Western Zones. These changes in the German chemical plants are of interest to chemical engineers of this country because of the effects on our industry.

GERMANY'S fabulous I. G. Farben cartel is in the very advanced stage of dispersal but a number of steps necessary to give final effect to the new pattern are stymied by the deterioration of relations among the four occupying powers and particularly by East-West differences.

Whether or not the task of breaking up I. G. Farben, which the four powers set out to do together, will be completed on a quadripartite basis depends on whether or not the Foreign Ministers Conference, which is in session as this is written, can resolve the basic issues comprising the entire German problem. Failure to avert a definite East-West split, on the other hand, will not prevent the task being completed along separate but less satisfactory lines.

The four powers, even though operating under a quadripartite directive, have tended to execute the de-cartelization of I. G. in accordance with their own political and economic philosophy toward Germany. This factor underlies what has been done thus far and it will influence the final pattern.

Basis for Action Against I.G.

Within six months after the end of hostilities, the four-power Allied Control Council had passed Law No. 9 directing the dissolution of the combine. Early action against Farben has seemed to the four occupation powers, who at that time were acting in close harmony born of war and victory, to be a measure as necessary to their mission as disarming the Wehrmacht.

It was not necessary to await the current war crimes trial of I.G. Farben officials to establish a basis for the action. An I.G. director had boasted at the time Germany had overrun Europe that, without the intensive concentration and development achieved by the combine in the chemical industry, Germany's success, which at that time appeared permanent, would have been impossible.

The trial has shown this to have been no idle boast. According to the evidence, Farben had synchronized all of its activities with the military planning of the German high command at a very early date, thus establishing its responsibility toward promoting aggressive war. Its use of foreign connections to assist Germany's preparations for war likewise was well documented at Nuremberg.

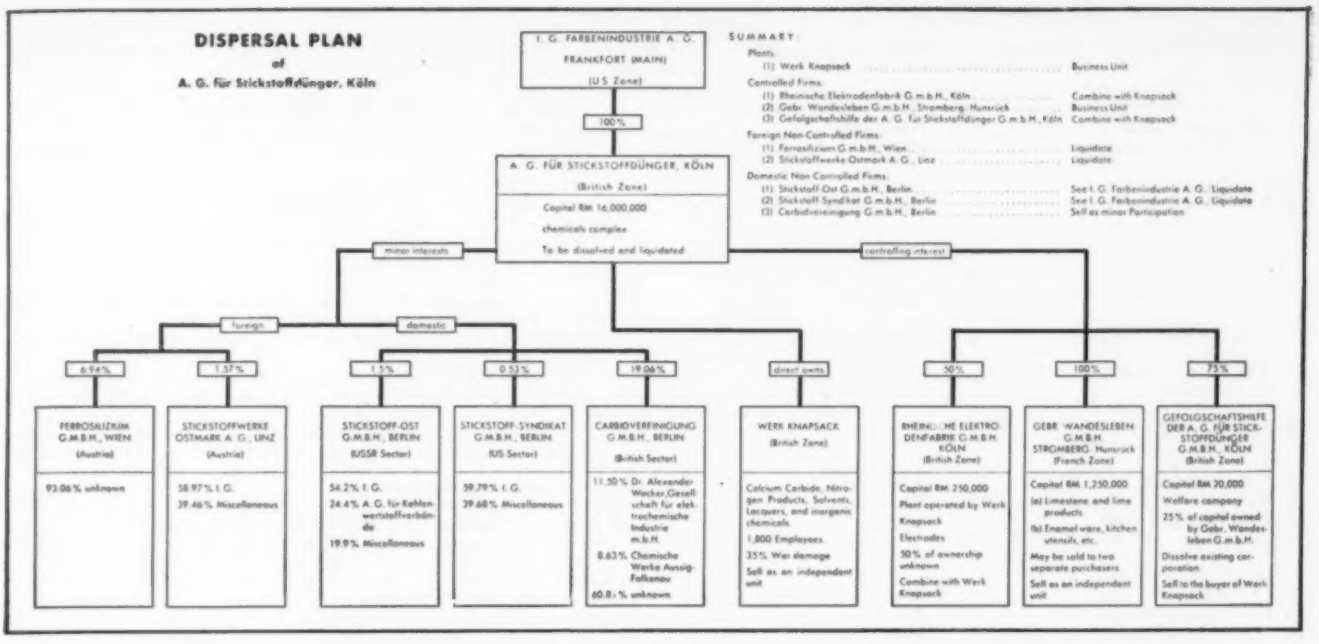
Law No. 9 seized the assets of I.G. Farben and its controlled companies within Germany and vested title thereto in the Allied Control Council. It established a committee of four control officers, one for each zone, to determine the policies for implementing certain objectives, the chief of which was dispersion of ownership.

Mechanics of Dispersal

The Farben combine owned, controlled or had an interest in 400 firms in Germany and participation in over 500 foreign enterprises. It controlled 85 percent of Germany's chemical industries. The combine's assets have been estimated conservatively at over 6 billion marks (at 40 cent exchange rate), with a payroll in 1943 of 250,000 people and sales in that year totaling over 3 billion marks.

Ferreting out I.G.'s German assets alone took about nine months. In addition to ascertaining the physical assets owned or controlled directly by the combine, there was the problem of tracing indirect holdings which resulted from ownership and control of firms by I.G. subsidiaries.

The initial step in the I.G. dispersal process was to eliminate the central accounting, and the sales organiza-



Typical of the avenues of de-centralization of the great combine is that of one of its units, Stickstoffdünger

tions, and to require that each of the operating companies develop its own bookkeeping, accounting and sales organizations.

Dispersal Procedure

The dispersal procedure has three main aspects: (1) disposition of minor participations, (2) liquidation of assets not essential to the operations of independent companies, and (3) creation of "independent units."

Where Farben holdings in a firm were less than 50 percent and there was no evidence of control, it was determined merely to dispose of the Farben stock. (Farben control is presumed where holdings were 50 percent or more. Such cases are examined more carefully to determine whether or not actual control existed. If it did, the unit is treated the same as those actually owned by I.G.). It has been left to the Farben control officers in each zone to find suitable buyers for this stock, but no attempt has been made yet to market it. However, the U.S. and British intended to offer the stock to the public after Jan. 1, 1948, unless a currency reform was adopted beforehand. Those undertakings, including many of the sales offices and welfare companies, not considered suitable for incorporation in an independent unit were to be liquidated.

Most important objective was the creation of independent units, each self-operating and economically self-supporting. The actual formation and preliminary organization of such units with their own independent management, sales and accounting groups has been in progress for the past year. The way it has been handled and the rate of progress has varied considerably in the four zones.

It was provided that each unit should operate under an appointed German trustee until a plan for final disposition of stock and title of ownership is adopted. The four powers thus far have failed to agree on such a plan. However, a proposed U.S.-British procedure, to which the French have given partial concurrence, is significant in view of a possible split Germany.

The Anglo-American sponsored plan provides for shares or other evidence of ownership in the new companies to be offered for sale to the German public at controlled prices. It makes provision for the foreign stockholders of I. G. Farben and its controlled companies to participate in the ownership of each of these new enterprises, to the extent to which they participated in the former Farben combine, otherwise allowing participation of foreign capital in conformity with the general policy which may be adopted by the Allied authorities.

It provides for the sale of all remaining assets, with payment to be made in German currency; and for payment to be made in German currency to the creditors of the concern subject to any special arrangement which may be authorized by the Control Council in respect to foreign creditors generally. It provides for ultimate distribution to acceptable German stockholders of I. G. Farben and its controlled companies of any surplus after payment of expenses of administration, and payment to creditors.

A vital factor in the plan is a provision that the disposal of shares in the new undertakings should not take place until after monetary reform has been put into effect in Germany, or until Jan. 1, 1948, at which time the question was to have been reconsidered.

Reservations concerning this procedure have been made by the French. They feel that it may be very difficult and perhaps dangerous to float on the market in a reasonable space of time shares of stock of a huge amount. The French also lay great stress, as a security measure, on the necessity of control of the management of major enterprises through Allied representation.

Soviet Policy

The Soviets, whose policy is influenced strongly by reparations demands and their own ideology, take an entirely different view of how the new corporate entities should be launched. They want ownership of the independent units to be disposed of on such conditions as will be agreed in each zone with the government of each Land or Province and in conformity with the existing legislation and constitutions of each Laender. This procedure, of course, fits into the existing pattern of Soviet-sponsored German state ownership and ownership by Soviet stock companies.

The Soviet plan provides for an ultimate distribution to stockholders in Reichsmarks, on a graduated scale, whereby the small stockholders would be paid the maximum and the larger

Production Capacities Declared Available for Reparations Out of I. G. Farben Plants in US-British Zones in Pursuance of New Level of Industry Plan

Name of Plant	Location	Capacities Earmarked for Removal
1. I. G. Farbenindustrie AG	Dormagen	Part plant, comprising section for production of Perlon U.
2. I. G. Farbenindustrie AG	Elberfeld	(a) Section for production of cellulose derivatives, (b) section for production of miscellaneous resins.
3. I. G. Farbenindustrie AG	Holten	Plant for production of ethylene oxide and ethylene dichloride.
4. I. G. Farbenindustrie AG	Leverkusen	(a) Section for production of Sulfigran (sodium sulphide by hydrogen reduction of sodium sulphate), (b) section for production of atabrin, (c) section for production of polyamides and miscellaneous resins, (d) section for production of hydrazine hydrate, (e) part of section for production of activated carbon, (f) part of section for nitration of toluene.
5. I. G. Farbenindustrie AG	Uerdingen	(a) Section for production of electrolytic chlorine and caustic soda, (b) part of section for production of alkyd resins.
6. I. G. Farbenindustrie AG	Zweckel	Plant for production of ethylene oxide, ethylene dichloride, polyethylene, bleaching powder.
7. I. G. Sauerstoffwerk	Duisburg	Plant for production of liquid oxygen and bottled industrial oxygen.
8. Dynamit, AG	Schlebusch	Part plant, comprising (a) section for distillation of glycerine, (b) part of section for production of trinitrotoluene.
9. Dynamit, AG	Troisdorf	(a) Section for production of nitropentia, (b) section for production of Vulcan fiber, part of section for production of phenol plastics, part of section for making celluloid.
10. I. G. Farbenindustrie AG	Gersthofen	Part of section for production of W.
11. Kalle and Co. AG	Wiesbaden	Part of section for production of methyl, ethyl cellulose type products.
12. I. G. Farbenindustrie	Hoechst	(a) Part of section for production of Uresin, (b) part of section for production of polyvinyl acetate, (c) section for production of Carboresin, (d) section for production of sulphur black, (e) part of section for production of solvents, (f) part of section for production of chlorinated solvents, (g) part of section for production of dinitrobenzene.
13. I. G. Sauerstoffwerke	Griesheim	Plant for production of industrial gases.
14. I. G. Sauerstoffwerke	Kassel-Mittelfeld	Plant for production of industrial gases.

stockholders the minimum compensation. Apparently they would make no provisions for creditors. They do not feel that waiting for currency reform is necessary.

The Russian attitude is based also on a curious quirk of history. In translating the Potsdam agreement from French into Russian, the word "seize," as applied to Farben assets erroneously, was made to read "confiscate." This slip of the pen has made Farben negotiations difficult in many ways.

No action has been taken in respect to property outside Germany which was owned by I.G. and its controlled units. Title is now vested in the German External Property Commission, which eventually must effect a disposition in consultation with the Farben Control Committee. Likewise I.G. assets in the disputed Polish-occupied territory east of the Oder-Neisse line have not yet been dealt with.

The Box Score

In implementing Farben de-centralization within the full meaning of the law the U.S. leads the other three occupying powers. Of a total of 199 installations owned or controlled by I. G. Farben, 47 of an ultimate 51 already have been made into independent units with trustees appointed for almost all of them, 8 have been consolidated with other installations, 77 have been ordered liquidated and 67 remain to be settled. Of the 67 outstanding, 58 are sales offices and 6 welfare offices, some of which will be combined with independent units. In terms of assets, 92 percent of the total in the U.S. zone have been considered and their liquidation or independent operation determined.

While generally in agreement with the U.S. and Farben policies in principle, the British have stalled in their implementations of the law. They have created 45 independent units and recommended 63 liquidations, leaving 75 on which no action has been taken. However, the 75 outstanding include the "big five" of the British zone, namely, Leverkusen, Dormagen, Elberfeld, Krefeld and Uerdingen. These plants represent more than 56 percent of all tangible Farben assets in the British zone, which fact has materially affected actual dispersion of both manufacturing and sales activities as compared to the U.S. zone.

The French have created 16 independent units and recommend 9 liquidations out of a total of 25 installations in their zone. The real issue, however, centers around the Ludwigshafen plant, which represents 92 percent of the Farben assets in the French zone. It is significant too that Ludwigshafen lies outside the Saar territory, which undoubtedly will be ceded to France.

No definite steps have been taken yet toward grooming Ludwigshafen for independent operation. The French, who have a military administration for the plant, exert a tight control over Ludwigshafen and have managed to favor it with sufficient power and raw materials to get a production which is higher than the average for I.G. plants under present economic condition. The plant is producing urea at almost full capacity—400 to 500 tons per month—with 80 percent going as exports to France or to other countries for barter trade. Nitrogen is being produced at 80 percent of prewar level, thus making the French zone self-sustaining in fertilizer. Roughly 60 percent of the plant's overall production goes for export, chiefly to France.

Soviet Zone Installations

Farben installations in the Soviet zone totalled 201, of which 31 have been designated as independent units and 86 have been recommended for liquidation. Of the Farben properties about which no final official action has been taken, 63 are brown coal mines.

Title to most of the former Farben operating units in the Soviet zone is vested either in Soviet stock companies or in the Land governments. It is significant that the big five of the Soviet zone, Leuna, Bitterfeld, Scoupau, Wolfen Farben and Wolfen Agfa are Russian shareholder companies.

Soviets apparently consider at least some of the shareholder plants as reparations property. While a partial removal of productive capacity has been made in all cases, they have preferred to leave the remainder to operate in Germany but reserve the right to take it at any time.

Soviet long-range economic policies for their zone are carefully guarded secrets, if, indeed, they have been determined.

Following data on the re-organization of Wolfen Farben illustrates how a typical Soviet shareholder company is formed;—name of business, government joint-stock company for dyestuff manufacturing, Kraska—Management: Moscow.—Branch establishment in Germany: Halle/Saxony.—Constitu-

Effect of Reparations Removal on Three Major Plants in Soviet Zone, Comparing Normal (1944) With Current Remaining Capacities

Bitterfeld

Unless otherwise indicated all figures are in metric tons per annum	Normal Capacity (1944)	Current Capacity Remaining in Germany
Caustic soda (40%)	120,000	60,000
Chlorine (gas)	62,000	36,000
Chlorine (liquid)	24,000	7,200
Bleaching solutions (commercial strength)	12,000	12,000
Hypochlorite of calcium	?	none
Calcium chloride (solid)	2,160	2,160
Calcium chloride (100% solution)	none	4,800
Bleaching lime	960	960
Chromic oxide	?	none
Low temperatures electrodes	7,200	2,400
Potassium bichromate	?	none
Potassium chlorate	15,000	7,500
Potassium permanganate	2,400	840
Sodium chlorate	15,000	7,500
Potassium chromate	?	none
Phosphorous (yellow)	?	?
Siliron (used to produce)	.....	.....
Trosilene trade products (soaps)	18,000	18,000
Hydrochloric acid	.....	19,200
Formic acid	7,200	1,800
Chlor-benzoic acid	2,000	2,000
Calcium formate	10,800	3,600
Chlor-benzene	4,800	4,800
Chlor-toluene	600	360
Sodium formate	1,200	none
Phosphorus trichloride	6,000	3,300
Phosphorus oxychloride	4,200	960
Oxalic acid	1,200	1,440
Tricresyl phosphate	4,800	2,160
Carbon tetrachloride	9,600	9,600
Miscellaneous organic products	10,000	10,000
Igelit—new	18,000	3,600
Magnesium	3,600	none
Calcium (metal)	?	72
Tungsten	?	none
Molybdenum	?	none
Flints for lighters	140	70
Nitric acid (50%–60%) (for fertilizer)	17,400	17,400
Calcium ammonium nitrate	34,000	34,000

Wolfen Farben

SO_2	?	7,200
Sodium sulphide (100%)	2,000	none
Hydrogen cyanide (20% Be)		
Byproduct	15,000	15,000
Synthetic	14,400	7,200
Sodium sulphate	1,800	1,800
Sulphuric acid (100% basis)	153,000	9,000
Cement (gypsum)	170,000	none
Nitric acid (as weak acid)	206,000	42,000
(as strong acid)	76,000	19,800
Sodium bisulphite	4,200	300
Sodium nitrate	36,000	36,000
Sodium nitrite	7,200	7,200
Calcium ammonium nitrate	135,800	84,800
Potassium nitrate	4,800	1,800
Cresol	4,800	3,000
Nitro-chlor-benzene	?	some available
Hydroquinone	?	some available
Para-amino-benzoic acid	?	some available
Mersolate (not indentified)	2,800	4,600
Mersol	30,000	20,000
Vanillin	?	small
Lausette (trade brand)	1,200	1,200
Ether	4,200	4,200
Chlor-benzene	5,000	5,000
Amido sulphuric acid	6,300	3,000
Film—roll	9,000	500 m [1]
Film—cut	480	25 m [1]

Wolfen-Film Agfa

Photo chemicals	648	30 tons
Blue print paper	none	100,000 m [2]
Sound film	none	7,000 km
Metallic foil (film wrapping)	none	300,000 m [2]
Cellulose acetate	44,000	6,600 tons
Cellulose fiber	28,800	3,900 tons
Artificial silk	5,000	1,000 tons
Technical fibers	?	100 tons
Synthetic sponges	3,600,000	2,500,000 pieces
Yeast and foods	none	300 tons
Sausage casings	none	500,000 pieces

tion confirmed by a degree of Ministry for Foreign Trade of USSR on Jan. 1, 1947.—Business registered in the trade register of the USSR on Jan. 31, 1947.—Registered in trade register of country court at Halle/S, application filed Feb. 18, 1947—Capital: 120,000,000 rubles, divided into 12,000 named shares, 10,000 rubles each. Founder and only partners: General Administration of Soviet capital abroad of the Ministry of Foreign Trade with a capital of 84,000,000 rubles—70 percent. 2. Vsesojnoje Objedinenije "Rasnoiimport" with 36,000,000 rubles—30 percent (selling of shares only with approval of the chairman)—Russian directors and members of the top management have been named but most of them have not yet been seen at the plant.

Reparations

Effect on Peacetime Capacity; Western Zones—Part of the capacity of 14 Farben plants in the fused U.S. and British zones has been earmarked for removal as reparations in pursuance of the new greatly increased level of industry for the bi-zonal area.

These reparations demands are extremely light compared to what was called for under the old level of industry plan, which was based on the Potsdam Agreement. Under that plan several of these plants would have been declared surplus in their entirety.

Moreover, there are possibilities that even this program might not be implemented fully. An East-West split over Germany almost certainly would rule out the Soviet 25 percent share in these reparations. Western nation recipients might decide to forego their share in the interest of an all-out drive to make western Germany contribute to the Marshall Plan.

But if the productive capacity earmarked for reparations is taken, it will not represent the liability to Germany that is generally supposed. This is because it will be a long time before the German chemical industries are producing at prewar levels.

Furthermore, capacities were chosen on the basis of their being surplus to normal needs and with consideration for maintaining the necessary balance in the industries affected. Where part of a section of a plant is earmarked for removal, reference is to facilities whose subtraction will not hamper operation of the remaining system.

How much value the dismantled facilities will have for the recipient nations is difficult to ascertain offhand. Successful operation of relocated facilities is contingent upon three basic conditions: (1) availability in the recipient countries of installations suitable for incorporation of the dismantled equipment, (2) access to the raw materials which the equipment was designed to utilize, and (3) the engineering skill in dismantling and re-locating the facilities.

The only other Farben plant in the western Germany which may yield reparations is Ludwigshafen in the French zone. A substantial part of the plant has been offered but no action has been taken as yet.

Effect on Peacetime Capacity; Eastern Germany—The "iron curtain" is more than a figure of speech and consequently information on any economic matter pertaining to the Soviet zone is usually piecemeal and somewhat vague. This is particularly true of the subject of reparations, which in the case of the Soviet zone includes both capital goods removals and current production.

It is estimated that over 40 percent of I.G. assets in the Soviet zone have been removed. And, as previously explained, those plants being operated by Soviet stock companies might be termed "reparations" as the Soviets have reserved rights to remove them.

Reparations trend in the Soviet zone

has been significant. For about a year after the end of hostilities the emphasis was on removal of productive capacity. Then it changed to reparations out of production apparently for two reasons: (1) technical difficulties involved in setting up dismantled equipment, (2) the urgent need for chemical products.

An official Soviet report to the Farben Control Committee, compares the 1944 capacities of three major Farben units in the Soviet zone with those retained. The three plants, Bitterfeld, Wolfen-Farben and Wolfen-Agfa are Soviet-owned as are the other two major Soviet zone plants, Skopau and Leuna. The effect of reparations removals on the capacities of the three plants can be taken as typical. It will be noted that in certain instances there is added capacity. And, it must be conceded that a number of these increased capacities are in the interest of the domestic economy.

Detailed information on reparations out of production is difficult to obtain. The percentages vary considerably, ranging downward from a reported 90 percent of Skopau's buna output, 60 percent to 70 percent of Wolfen's dyes and 50 percent of its cellwolle.

Prohibited Industries—The Potsdam Agreement provided that production of synthetic gasoline and rubber should be prohibited until Germany was in a position to meet her requirements out of imports. Also, production of synthetic ammonia was to be dealt with on the same basis until imports of nitrogen could meet requirements.

Maximizing Production

All of the four powers are maximizing production of these industries to the extent which raw materials will permit. The U.S. and Britain, in announcing their new level of industry, side-stepped making reversal of this policy but strongly intimated that this Potsdam principle would be scrapped. Farben controlled all but a few of Germany's Fischer-Tropsch plants and manufactured about 95 percent of its buna.

Dismantling of War Plants—Most of the enterprises classified as purely "war plants" made explosives. Half of these plants in the fused U.S. and British zones already are dismantled or in process of removal. And, the four powers are committed to dispose of all such installations. Nitric acid plants in this category are being retained, at least temporarily, in the interest of the fertilizer program.

Even though such plants yield relatively little reparation of value, it has not been deemed feasible to convert them to peacetime use. Most of them were built after 1939, and thus not considered part of Germany's peacetime industry. Only general purpose equipment is made available for reparations, the remainder of the capacity being destroyed.

Patents and Trademarks

Farben owned 18,000 German patents and patent applications directly at the time of seizure and its subsidiaries and controlled companies owned another 12,000. Some 1,500 patent licenses were held by I.G. exclusive of those held by subsidiaries. These licenses generally covered a plurality of patents. I.G. trademark registrations in Germany numbered about 5,000 and a like number is estimated to be held by subsidiaries.

The four powers thus far have failed to agree on a basis for disposing of I.G. patents and trademarks. In fact, the question has been referred to higher level by the Farben Control Committee. The U.S. position is significant, because the British have indicated agreement except for minor procedural details.

The American proposal, in essence, provides that:—Purchasers of I.G. Farben units will receive automatically, as partial consideration for the purchase price, the right to a license under any German I.G. patent, and whatever patent applications may be converted into patents. For the license they will pay a nominal registration fee. All other applicants, domestic and foreign, shall be given licenses without discrimination and shall pay the nominal registration fee plus a moderate royalty.

Licenses shall be non-exclusive, non-transferrable, and not subject to mortgaging. No sub-license shall be granted under them. Legal ownership of the patents shall remain in Allied hands, but a non-profit German licensing bureau will be established to administer the system, except that foreign applications will be made to Allied authority. The license registration fee will be sufficient merely to cover the expenses of the German licensing agency. Royalties will be collected by the Allied authorities.

The trademark "I.G. Farben" or any variations of the names as well as the names of major elements of the combine such as "Agfa" and "Bayer" would be outlawed. Other trademarks not readily recognized as belonging to the combine would be retained and sold with the plants to which they belong, if such distribution is possible.

French favor alloting specific patents exclusively to specific units, instead of making all patents available to all units. The Soviets, who had indicated approval of the U.S. position until recently, now prefer that companies keep all patents which they actually used prior to 1945 and that all others be cancelled.

Soviets favor keeping all trademarks such as Agfa and Bayer, only outlawing I.G. Farben or any reference thereto. Apparently they are counting on these trademarks, especially Agfa, being of some value in selling exports from plants under their control. The British, incidentally, tend to feel the same way as the Russians toward the trademark issue. Another trademark complication arises from the fact that most countries seized all patents and registered trademarks owned by German nationals as well as companies owned and controlled by Germans.

This problem has already caused the Anglo-American bi-zonal economic administration a big headache. It had some $20 million worth of packaged and otherwise trademarked stocks of pharmaceuticals at Leverkusen from which it was anxious to make dollar exports but feared possible legal resistance from the governments of prospective buyers. The problem was referred to Washington and London and the result was a directive to the bi-zonal authorities to dispose of the stocks at their own discretion. In other words, they were told to sell wherever they could get clearance.

It has been suggested that the countries which have seized German patents and trademarks be given a specific period in which to consider which ones they desire to appropriate and then turn the remainder back to the German nation for disposition by the occupying powers. While this measure would remove uncertainty over those patents and trademarks which were not to be appropriated, it, of course, would not contribute to the solution of the problem concerning those which are to be used. Consequently, a conference of countries concerned with German patents and trademarks will be necessary.

The patent problem goes beyond the disposition of those in existence. Decision also must be made eventually on these matters: (1) 8,000 to 10,000 pending patents, (2) an estimated 5,000 patentable processes in the heads and notebooks of Farben chemists, and (3) several hundred trade and professional secrets, which if patented would present an ownership problem.

Chemical Process Control With RADIOACTIVITY

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HOW RADIOACTIVE MATERIALS MAY BE UTILIZED FOR CONTROLLING PROCESSES AND OPERATIONS IN THE CHEMICAL PROCESS INDUSTRIES

Radioisotopes are now available to industry. So far, they have been mainly used in basic research but some work and much thought has been given to developing industrial uses. Two classes of applications seem to be most promising, namely: as tracers in chemical reactions and as radiation sources in instruments that measure scattering of gamma rays. The author outlines suggested applications and discusses some of the problems involved.

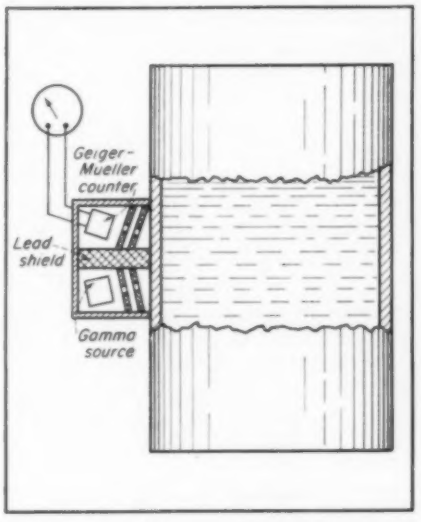


Fig. 1—Specific gravity is measured by a Geiger-Muller counter that detects back-scattering of gamma rays

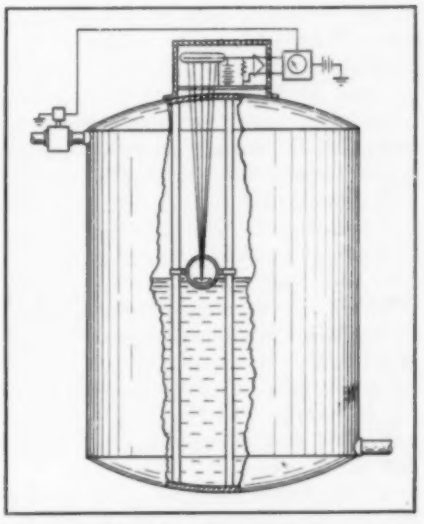


Fig. 2—Liquid level instrument uses a counting-rate meter and a guided float containing a gamma ray emitter

SINCE radioisotopes became available from Oak Ridge a little more than a year ago, much publicity has been given to advances in fundamental research and in the field of medicine brought about through the use of radioisotopes. Little except vague generalities has been written about new developments which may be expected within the next few years from the application of radioisotopes and tracer techniques to industrial problems, both in the plant and in the industrial research laboratory.

Such a situation is to be expected because, prior to the Manhattan Project, few people had dreamed that we would ever have inexpensive radioactive materials of widely varying characteristics available in the relatively large quantities required for industrial purposes. Until last year, the minute quantities of radioisotopes available from cyclotrons were of such a low order of magnitude that few workers in radioactivity conceived of their use in large scale industrial processes where daily consumption might run in millicuries instead of a few microcuries as in typical prewar research.

However, government regulations regarding the use of radioisotopes have not given industry full encouragement to begin development of industrial applications of radioactivity. Up to the present radioisotopes have been restricted to use in publishable research, either fundamental or applied, and for medical purposes. No provision has yet been made for permitting their utilization in any industrial process. Now, however, steps are being taken by the Atomic Energy Commission to improve this situation.

The chemical industry, in particular, has been built on a highly competitive basis and process secrets are numerous. Some manufacturers are reluctant to pursue research on potential industrial applications because of the requirement that results of such work be freely available to others. The patent situation on discoveries of patentable processes utilizing radioisotopes is not entirely clear regarding the right to exclusive use by the inventor or his assignee. Litigation proceedings of one or more test cases in a court of law will clarify this issue.

Questions arising from potential health hazards both to plant workers and to the consumer are further deterrents to activity in the industrial field. Despite the excellent safety record of the Manhattan Project, there still remains the unanswered question of the

long term effects from continued exposure of personnel to less than the currently accepted conception of tolerance radiation dosage.

There is the ever present threat of nuisance suits instigated by consumers against manufacturers who permit products to leave their plants containing small amounts of residual radioactivity. Keeping the radioactivity remaining in finished products at a level far below tolerance will not be difficult. Even minute amounts of radioactivity in consumer products may, for a time, cause the manufacturer considerable embarrassment due to consumer ignorance and to inadequate precedent in court rulings of damage suits involving low concentrations of radioactivity.

Uses of Radioisotopes

Literally tens of thousands of potential industrial uses of radioisotopes exist. Virtually every industry can profitably utilize the properties of one or more of the hundred odd radioisotopes whose half lives and availability permit their consideration for industry. At present there is need for serious and penetrating consideration of the potentialities of radioisotopes in industry. Active development is needed for those uses which can do a more efficient job than currently available methods in improving process control and quality, lowering processing costs by saving labor and material, or serving as a warning mechanism to protect personnel from health hazards inherent in a process.

To get some conception of the industrial usefulness of radioactivity, let us consider how the rayon industry might use radioactivity and tracer techniques. The rayon industry is chosen not because it is particularly adaptable to these techniques. Rather it is because uses adaptable to this industry are typical of those in many others such as rubber, plastics, fine chemicals, petroleum refining, and paper.

Before making an analysis of the rayon process, it should be understood that many of the uses of radioactivity which will be described have not yet been seriously investigated as commercial possibilities. The examples given are merely illustrative of what might be done rather than what has been done or what is contemplated in the immediate future.

The process is as follows: Cellulose, usually in the form of sulphite paper pulp, is treated with caustic to form alkali cellulose. Carbon disulphide is then reacted with the alkali cellulose to produce cellulose xanthate, a crumbly solid. The xanthate is formed into a solution of high viscosity by the addition of water and sodium hydroxide. This solution, called viscose, is forced under pressure through spinnerettes containing tiny holes into a coagulating bath to form yarn filaments. The filaments are then washed and passed through a desulphurizing bath to completely remove all residual sulphur. They are next coated with a lubricant such as sodium oleate, a polyvinyl alcohol, or a petroleum base oil.

If tracer quantities of radioactive sulphur-35 as carbon disulphide are added in the xanthating process, there are several uses to which it could be put in process control.

A part of the sulphur is removed in the coagulating bath and the rayon filament is completely freed of it in the desulphurizing bath. Continuous routine check of sulphur removal can be made by placing a Geiger-Mueller counter in close proximity to the rayon filament or the solutions through which it passes. Since the radioactive sulphur is a fixed proportion of total sulphur present, the total amount of sulphur removed in the coagulating bath can be quickly determined. Also a check is easily made after the desulphurizing bath to determine whether complete removal of sulphur has resulted. It is quite possible that automatic electronic controls could be devised to keep the coagulating and desulphurizing baths within predetermined concentration ranges by coupling the output of the Geiger-Mueller tubes through a suitable servo-mechanism to valves on chemical solution tanks.

Safety Devices

A health hazard exists at several stages in the process. Hydrogen sulphide, carbon disulphide vapor, and mercaptans, all highly poisonous, are liberated in the coagulating bath. The use of carbon disulphide tagged with sulphur-35 can alleviate this hazard. Since the sulphur in both the hydrogen sulphide and in the mercaptans originates in the carbon disulphide, these compounds will also contain radiosulphur. Radioactivity monitoring devices placed in areas where leaks are likely to occur can be made to sound an alarm when sulphur containing gas or vapor escapes.

Such monitoring devices can be made sufficiently sensitive so that they will detect a leak before plant personnel will smell the odor of the escaping gas. Even more useful is a portable radioactivity detection instrument for locating the exact spot at which the leak is occurring. The low energy beta radiation of sulphur-35 makes it somewhat difficult and expensive to use for this purpose; however, it can be made to operate successfully. An alarm system such as this should prove even more valuable in plants processing highly poisonous gases which do not have distinctive odors or which are cumulative poisons.

In preparing the viscose solution, cellulose xanthate crumbs are dissolved in sodium hydroxide to form a solution of a predetermined concentration. The dissolving and dilution process can be automatically controlled by use of radioactivity techniques. A patent has been granted (U. S. Patent 2,304,910) for determining specific gravity of fluids by measuring backscattering of radioactivity from the solution being measured.

Specific Gravity Measurement

Briefly, this method is as follows: A collimated source of hard gamma radiation is placed outside of the container holding the liquid for which the specific gravity is desired. The radiations impinge at an acute angle on the container wall. A Geiger-Mueller counter coupled to a counting rate meter is mounted to receive scattered radiation from the gamma source. A lead shield is placed between the counter and the source of radiation, absorbing virtually all radiation from the radioactive source which is emanating in the direction of the Geiger-Mueller counter. Fig. 1 shows a diagrammatical representation of the apparatus.

A substantial portion of the rays enter through the container wall into the solution. The rays are scattered within the fluid in the container and the amount of scattering per unit volume depends upon the density and composition of the fluid. Considerable scattering will result as the rays pass through the container wall but knowing the density and thickness of the wall a constant correction factor can be applied. A portion of the scattered rays are reflected back to the Geiger-Mueller counter, the counting rate detected being a function of the intensity of the gamma source and the density and thickness of the materials upon which the rays have impinged. For a given system the counting rate meter can be calibrated to read directly in specific gravity. It is claimed this device has been used with a high degree of reproducibility in measuring fluid densities between 0.7 and 1.0 g. per cc. in a pipe $6\frac{5}{8}$ in. O.D. with wall thickness of 0.3 in.

An instrument such as this can be easily coupled to valves automatically controlling the amount of caustic and water to be used in dissolving a batch

of cellulose xanthate to form a solution of predetermined specific gravity.

If desired, a higher degree of accuracy can be attained without the necessity of shielding the Geiger-Mueller counter by placing the source of gamma activity within the tank and measuring the amount of radioactivity detected by a Geiger-Mueller tube placed outside the container.

The backscattering phenomenon has many useful applications. For example, using a similar instrument to that shown schematically in Fig. 1, piping and tanks can be inspected for internal corrosion without draining or interfering with the process in any way. If the density of the liquid in a pipe and the material from which the pipe is made are known, then it is not at all difficult to calibrate the counting rate meter in terms of pipe wall thickness.

This instrument integrates pipe wall thickness over an area of roughly 1 sq. in. and will measure thickness to within about 5 percent. Such equipment is now made commercially and is particularly valuable in industrial processes where corrosion problems are serious. It does have the limitations of being insensitive to deep pitting and scale corrosion where corrosion products adhere to the metal.

Liquid Level Gage

A liquid level gage utilizing radioactivity has recently been developed which can be used to indicate liquid level in any tank used in the manufacture of rayon. This gage is particularly useful where highly corrosive liquids are to be measured or where it is desired that the tank have no openings through which gas or vapor can leak. A float containing a hard gamma emitter, which is constrained to vertical movement, is placed inside the tank. A Geiger-Mueller counter coupled to a counting rate meter calibrated in liquid depth is mounted directly above the float and outside of the tank.

As the distance between the radioactive float and the Geiger-Mueller counter changes there is a corresponding change in the detected counting rate which is indicated on the calibrated meter. The output of the Geiger-Mueller counter can be utilized to open a filling valve when the liquid falls below a predetermined level. Fig. 2 shows a diagrammatical representation of this equipment.

Dyeing process control is, for the most part, an art rather than a science because so many independent variables are present. Radioactivity can be of considerable assistance in controlling two of these variables, namely the dye concentration in the dye bath and the weight of dye absorbed by the fabric. The continuous dyeing process in which fabric is passed through a dye vat in a continuous length is particularly adaptable to this type of control. If one or more radioactive atoms were incorporated into the dye molecule and tracer quantities of it were mixed with the normal dye, the concentration of dye present in either the cloth or the dye vat could be continuously and automatically determined by Geiger-Mueller counters. Electronically actuated controls can regulate the dye bath concentration in such a way that the weight of dye per unit area of cloth emerging from the dye bath will be a predetermined constant. Process controls such as these will eliminate substantial variations in shade between the beginning and the end of a dyeing run which sometimes result with presently used methods.

Tracing Reactions

The mechanism by which free sulphur appears in the coagulating bath and in the yarn is not fully understood. Sodium sulphite is added in the xanthate dissolving process to retard the appearance of coagulable cellulose. It is not known whether the sodium sulphite produces more sulphur in the yarn than does the carbon disulphide which reacts to form the xanthate. Tracer amounts of sulphur-35 incorporated into either carbon disulphide or sodium sulphite molecules can follow the course of sulphur from either source.

The presence of small amounts of manganese, iron, copper, chromium, and certain other metallic ions in the viscose solution have resulted in production of rayon filaments of inferior characteristics. These materials accelerate the aging and ripening process and if properly controlled they might be advantageously utilized to shorten the time required for ageing and ripening. Radioisotopes could be used in studies to determine the lower limit of metallic ion concentration which affects the aging and ripening rate, since this lower limit may well be below that detectable by conventional chemical methods.

In all industrial applications of radioactivity, considerable care must be exercised in choosing the proper level of radioactivity concentration and the proper radioisotopes to use for eliminating the health hazards of excessive radiation exposure of plant personnel. Every effort should be made to utilize isotopes of fairly short half lives and with as low an energy level as is consistent with desired sensitivity of the process control instrumentation. In locations where the radiation is unshielded from plant personnel it is quite important that only alpha or beta emitters be used unless gamma emitters in low concentration can be satisfactorily utilized.

Problems Involved

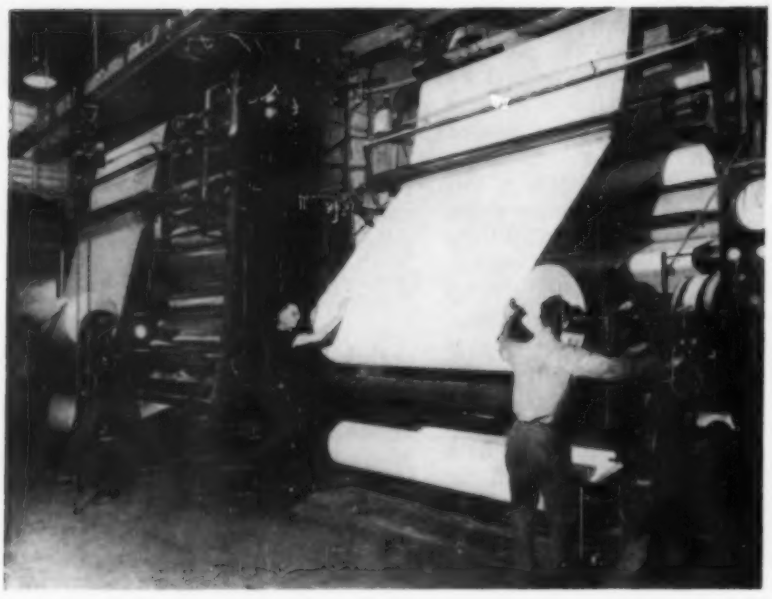
A further point of importance in considering industrial applications of radioactivity is the amount of activity remaining in the finished product. Most of the uses described in this article provide for removal of the radioactive material during the process. In the few instances where this is not the case, radioisotopes of short half life should be used in sufficiently low concentrations as to constitute no health hazard to the ultimate user. Thus, it is evident that the extent to which radioactivity can be used in processes where it is not removed from the finished product is limited by the number of radioisotopes which have both the requisite chemical properties and a short half life.

At least 88 elements have one or more radioisotopes available from natural sources, from pile irradiation or from cyclotron bombardment which have half lives sufficiently long to be considered for use in industrial processes. Lack of diversity of radio elements is little cause for concern.

It is unlikely that radioactivity will cause widespread revolutionary changes in the process industries within the next several years. Inertia, lack of personnel trained in the field of radioactivity, and a general tendency of waiting for someone else to take the first step will all contribute to slow initial development. Furthermore, the advantages gained in utilizing tracer techniques are frequently out of proportion to the required capital outlay.

Undoubtedly radioactivity will very shortly be called upon to solve many problems which have seriously troubled industry for some time and for which no satisfactory solution has been found in any other method. These will be the first and probably the more spectacular applications. After that, imagination, economics, and ingenuity will determine the future course of radioactivity in industry.

Acknowledgment is made to M. H. Gurley of Esselen Research Corp., R. B. Finch of the Massachusetts Institute of Technology, F. C. Henriques, Jr., of Tracerlab, Inc., and Simon Williams of the Lowell Textile Institute for their helpful suggestions.



Fourdrinier machine improvements include anti-friction bearings, stainless head boxes, new drives direct connected to machines

Water filter supplies 3,000,000 gal. per day for mill and entire towns drinking water

Paper Mill Goes Modern—

FIRST MILL TO USE PEROXIDE IN DE-INKING WASTE PAPERS HAS ALSO INSTALLED NEW EQUIPMENT TO ACHIEVE SAVINGS

INCREASED production of high quality paper calls for modern methods and efficient operations. No one knows this better than the managers of the Newton Falls Paper Mill, an affiliate of McGraw-Hill Publishing Co. and Chilton Co. So they did not hesitate to modernize their mill, even though its oldest piece of equipment was only ten years old and most of its machinery had been installed only three or four years. When plans were made a year ago to streamline the book paper mill at Newton Falls, N. Y., they embraced changes in materials handling, de-inking, sulphite pulp preparation, machine room operations, finishing and shipping. Prize plum in the improvement pudding was the proposed shift to peroxide de-inking of waste papers containing groundwood. Now these plans have been realized. They are paying off handsomely in lowered costs and better finished paper.

Recent trends in the pulp and paper industry have led to a need for improved technique in the recovery of used papers. Shortages in pulp and paper supply have become more acute; consequently, recovery of usable pulp from lower grades of waste papers, and from papers containing a substantial percentage of groundwood, has become more urgent.

Recovery Processes

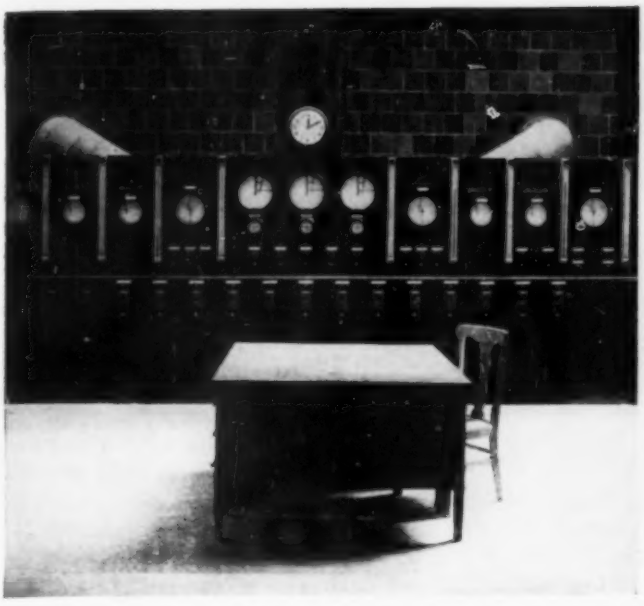
Conventional recovery processes, which have been giving satisfactory performance with waste papers essentially free from groundwood, have demonstrated serious shortcomings when applied to waste papers with a substantial groundwood content. Consequently, as increased quantities of groundwood entered into paper production, new problems arose in connection with the de-inking and bleaching operations in recovery processes.

A cooperative investigational program was undertaken by the technical staff of the Newton Falls Paper Mill and the Electrochemicals Department of E. I. du Pont de Nemours & Co. It led to the development of an improved process of de-inking waste papers in which sodium peroxide is an active agent.

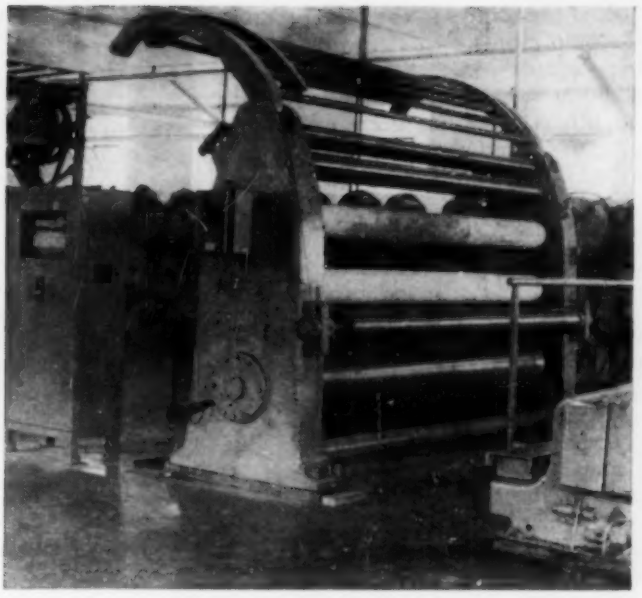
Better utilization of waste papers has resulted from the introduction of peroxide into the de-inking operation. This favorable influence is considered due to its ability to modify and solubilize the various ink vehicles, as well as the starches, glues and other organic components, encountered in waste papers.

Some bleaching and brightening are obtained during the de-inking operation. Furthermore, the peroxide persists to the end of the cooking step, in concentrations sufficient to inhibit the color reversion that groundwood undergoes when subjected to a hot, alkaline treatment. In this respect the functioning of sodium peroxide differs from its bleaching action on groundwood-sulphite mixtures as described in *Chemical Engineering*, October, 1947, pp. 92-96 and 140-143.

With the use of sodium peroxide in the de-inking process it is practical to utilize lower grade papers and yet meet the high standard in paper quality. The amount of magazine stock fed into the hydrapulper has been increased from 50 percent to 75 percent and the amount of ledger stock has been reduced from 50 percent



Instrumentation throughout mill has lowered costs and increased quality of product by closer control

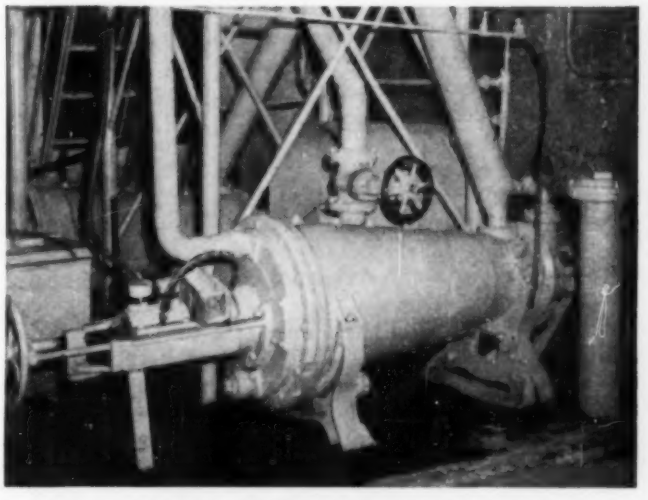


Micro jet coating machine is equipped with modern control devices such as electric eyes and moistograph

Now De-Inks With Peroxide

JAMES A. LEE
Managing Editor, *Chemical Engineering*

Sodium peroxide as a bleach and as agent in de-inking and re-working of waste paper has broad applications that are only in their infancy. The Newton Falls paper mill is the first to use it for de-inking. It is demonstrating the reductions that may be made in operating costs, improvements in quality of product, and other advantages that are to be gained from its use.



Refining machines of several types are used in the preparation of pulp before going to the machines

to 25 percent. At the same time the use of virgin pulp has averaged about 16 percent for the entire paper production.

Use of peroxide results in an increase in the over-all chemical costs. However, the economic advantages in the operations more than compensate for this increase in chemical cost.

The amount of caustic used for operating the process is about one-third of the requirements for satisfactory results in the caustic soda de-inking process. This decrease in caustic requirements is due to two factors: (1) satisfactory de-inking results are obtained in the peroxide process with less alkali than is required in the caustic soda process, and (2) peroxide has an alkali value slightly greater than its own weight.

The amount of sodium hypochlorite used in bleaching has decreased about 25 percent since the peroxide bleaching process was put into operation.

Reduction in the cooking temperature from 200 to 170 deg. F., together with the decrease in the cooking time from 4 to 1 hour, has effected a substantial savings in the use of high-pressure steam. No advantage was obtained by operating above 170 deg. F.

Higher production capacity is obtainable from existing equipment in the de-inking mill due to the shorter time schedules for defibering and cooking.

Yields have been uniformly higher due to less fiber degradation under milder cooking conditions.

Among the most important results have been the leveling influence and

greater uniformity in the brightness of the pulp ultimately obtained after the hypochlorite bleaching operation. In addition to better uniformity, the brightness level has been raised appreciably, from about 70 to 78 points as measured on the General Electric brightness tester.

Freer flowing stock and a closer formed sheet result. Peroxide tends to disperse the ink and makes washing of fiber simpler. With the new coating process in use at this mill it is possible to coat this grade of paper and get a good product.

Operation of the sodium peroxide process for de-inking for one year has demonstrated a worthwhile saving in costs with an accompanying higher quality product.

Briefly, the de-inking process consists of treating waste paper with sodium peroxide and caustic in a hydrapulper. It is then subjected to a mild cook. The cooked stock is passed over a riffler, screened, washed and bleached. After a final wash the stock is ready for the fourdrinier paper machine.

Bales of magazine and ledger papers are received at the mill by railroad. Fork lift trucks are used in unloading the paper, conveying the bales of paper either to storage or directly to the scales and hydrapulper. Installation of the fork lift trucks resulted in a saving of 32 man-hours per day in the loading and unloading of cars in the de-inking plant.

The batch of raw materials going into the hydrapulper consists of caustic soda, sodium peroxide and paper. The charge of 4,000 lb. of waste paper contains inks of every color in the rainbow. Previously, sufficient water has been put into the pulper to give the stock a consistency of 6 to 7 percent. This water has been heated to 180 deg. F. in a nearby heat exchanger, the heat coming from the dryers of the paper machines and from exhaust steam throughout the mill. To the hot stock are added 1½ percent sodium peroxide and 1½ percent caustic, based on dry weight of the paper.

The materials during hydration are maintained at a temperature of 160 deg. F. by direct injection of high-pressure steam. Five minutes is required for charging the hydrapulper, 15 min. for defibering, and 5 min. for pumping the slurry to one of the two cooking tanks. Enroute to these tanks the slurry goes through a positive displacement pump which has a rubbing action. Here the hydration of the pulp is completed.

In the cook chests pulp is circulated by high speed pumps. There is one turn-over every 6 min. The ducts are tile-lined. They have a capacity of 12,000 lb. of stock at 6 to 7 percent consistency. This equals the capacity of three hydrapulpers. The temperature of the stock is increased to 170 deg. F. Approximately 15 min. after the contents of the third pulper have been emptied into the cook chest most of the peroxide has disappeared. Stock remains in the cook chest until a sample no longer shows the presence of ink. This requires from 15 to 60 min. from the time the third hydrapulper has been emptied.

Diluted In Chest

When all ink has been removed from the stock it is pumped into the black stock storage chest where it is diluted to 4-5 percent consistency. These concrete chests are kept filled by drawing on the contents of one after another of the cook chests. Sufficient mechanical agitation is used to insure blending of stocks. At this point the process becomes continuous.

Stock is pumped from the black stock chest to a riffler. It then goes to a stuff box. Here the effluent from the No. 3 and No. 4 stock washers is added to the stock in order to dilute it to 0.8-1.0 percent consistency before going to the rifflers. After passing over the rifflers the stock passes by gravity onto flat stainless-steel primary screens. Acceptable stock passes through the 0.012-in. slits in the screens. All stock which does not pass through these openings goes onto flat stainless-steel tailings screens. Stock which passes through the tailings screen is returned to the black stock chest. Stock retained on the tailings screen is discarded.

Acceptable stock leaves the primary screens and passes over a vacuum washer. An automatic speed regulator keeps the material on the cylinder to serve as a filter pad, retaining the fine fibers and some of the filler material. This filter pad reduces the losses of both fibers and fillers by 50 percent or more. The effluent discharges to the sewer. This is the only material from the de-inking process which is discharged into the sewer.

From the vacuum washer the stock passes to a stock breaker, an agitated chest, where wash water (the effluent from the No. 5 bleach washer) is added. It then goes over two Lancaster cylinder washers equipped with a rubber-covered couch roll. Washed stock from the second Lancaster drops from the couch roll into a screw conveyor which carries it to the mixing tank. Here the sodium hypochlorite bleach liquor is added through a rotameter and is proportioned to the demand of the pulp (approximately 95 gal. of hypochlorite solution per ton of pulp or about 1 percent available chlorine on the weight of the pulp).

Hypochlorite bleaching is carried out under carefully controlled conditions, with consistency of the pulp and the bleaching temperature under fully automatic control.

From the consistency regulator the stock passes by gravity to the top of the tile-lined bleach stock chest. Capacity of the chest is 20 tons. Here the stock is retained for 2 to 2½ hr. to permit completion of the bleaching action. Temperature is held at 120 deg. F. Bleach stock is passed over another cylinder washer equipped with a rubber-covered couch roll. The effluent from this washer goes to a stock breaker chest along with the shower wash water from the No. 3 cylinder washer.

Consistency of the stock from the bleach stock washer is maintained at 4 percent. Since the de-inking process is now complete, the stock is pumped to the tile-lined concrete storage chest for de-inked stock. This chest is equipped with a paddle agitator.

Preparation and Development

Leaving the de-inked stock temporarily, we turn to the stock preparation and development system. Between 2,500 and 3,000 lb. of broke are put into a hydrapulper and pulped at 7 percent consistency. After it has been thoroughly pulped the stock is diluted to 4 percent consistency and pumped direct to the de-inked stock chest.

In the same pulper that is used for broke, new sulphite pulp, which the mill purchases, is hydrated at a consistency of 6 percent. It is then pumped to the tile-lined developing chest. It is next circulated through a hydrafiner until maximum tear-resistance has been developed in the sulphite. This stock is diluted to 4 percent consistency and pumped to a tile-lined sulphite storage chest, and from this chest to the tile-lined blending chest in which the stock is agitated by pumping. In these chests de-inked stock is blended with sulphite stock from the respective storage chests at a consistency of 4 percent. After blending, such materials as dyes, rosin size and alum are added and thoroughly mixed. The stock is then diluted to 3 percent. On leaving the blending chest stock passes through a blending dump chest, consistency regulators, jordan refiners and goes to machine storage ducts. Throughout these steps

in the preparation the consistency has remained at 3 percent.

Next the stock goes to fan pumps and to Dirtec units for removing dirt particles. The inlet capacity of a single primary Dirtec is 280 gal. per min., the number of units employed for any given installation depending on the volume to be handled. The pressure at which the stock enters the Dirtec is between 35 and 40 psi. There the collected dirt is removed periodically without interrupting the operation of the machine. These units have replaced the Bird screen and tailing screens on the paper machines. This substitution has reduced maintenance almost to a vanishing point and has saved the mill approximately 2 tons of stock a day that formerly went to the sewer from the tailing screens.

Stock is discharged from the Dirtec units to the head box of the fourdrinier paper machine and from there it goes onto the fourdrinieer machine where the sheet of paper is formed and dried. Between the first and second dryers a water solution of starch sizing is applied. This helps to prevent the clay coating material from striking into the sheet.

High-Speed Coaters

Rolls of paper are conveyed to the coating machines. The Waldron microjet coaters are capable of coating one side of the paper at the rate of 1,000 ft. per min. The coating is applied to the paper by a rubber roll which picks up the clay coating solution and applies it to the paper. The web of paper passes over another roll where the excess coating is blown off by a ribbon of air. The web travels over a rubber-covered suction apron and then comes off into a loop suspended in air. The height of the loop is maintained at a constant level by two electric eyes.

The paper web passes on a flat-level convevor through a straight-pass Ross tunnel dryer. The coating on one side of the web is dried by blasts of hot air. The hot air is controlled by four ovens at different points in the dryer. The temperatures of the ovens are graduated between 220 and 150 deg. F.

Moisture Control

Paper leaves the tunnel dryer, forms a loop, the height of which is controlled by electric eyes, and passes to a tension stack thence to the rewinder. Moisture in the paper is controlled by a Brown Moistograph instrument. The amount of moisture is found by measuring the electrical resistance from a detector roll in direct contact with the continuously moving sheet of paper at the dry end of the machine. Changes in resistance are measured on a potentiometer bridge circuit and recorded on a strip chart.

The roll of paper is returned to the coaters and the other side of the web is coated and passed through the tunnel dryer. When both sides of the web have been coated the roll is conveyed to the super-calender where the high gloss finish is developed on the paper.

A uniform finish is developed on both sides by the calender by means of a continuous constant-reading electronic Glarimeter. The instrument gives a reading of gloss on both sides of the web of paper as it is being super-calendered. It was developed recently through cooperative effort of Newton Falls' own technical staff and the Glens Falls Laboratory.

Rolls that will be shipped in this same form are conveyed to a rewinder, cut to size specified by the customer, wrapped, and loaded into a railroad box car for shipment. If the paper is to be shipped in the form of sheets, the roll is conveyed to cutters where ten rolls are sheeted simultaneously and then placed on a skid. Sheets are taken to the finishing room where they are hand-sorted by girls. The paper is sorted for low finish, half-sheets and any other objectionable features. Those passing inspection are wrapped and shipped.

Water Supply

A Hardinge water filter supplies 3,000,000 gal. per day for mill fresh water and the entire town's drinking supply. This filter has an automatic back-wash sand filter. It requires no operators. It is composed of a series of small beds, 8 ft. wide, extending the width of the filter. Each bed has its own outlet. In order to back-wash, there is a shoe on the back-wash unit which rides on top of the individual filtered water outlet. It forces clean filtered water back up underneath the sand in that bed and the effluent is pumped off into the sewer.

Control laboratories play important roles in the production of the high-quality products. They (1) analyze raw and finished water for control purposes, (2) set up de-inking procedures followed by the production department, (3) check each completed cook for consistency and cleanliness, (4) check sodium hypochlorite bleaching solution, (5) determine finished brightness of the pulp, (6) draw up charts to control consistency throughout the sulphite preparation and development system and check to see that these procedures are followed, and (7) determine tear-resistance developed. Each roll of paper that is made on the machines is tested and the results sent immediately to the machine-tender so that corrections in operation can be made without further delay. The laboratories also test and control coating solutions used on the microjets in order to govern uniformity of coating on the finished paper.

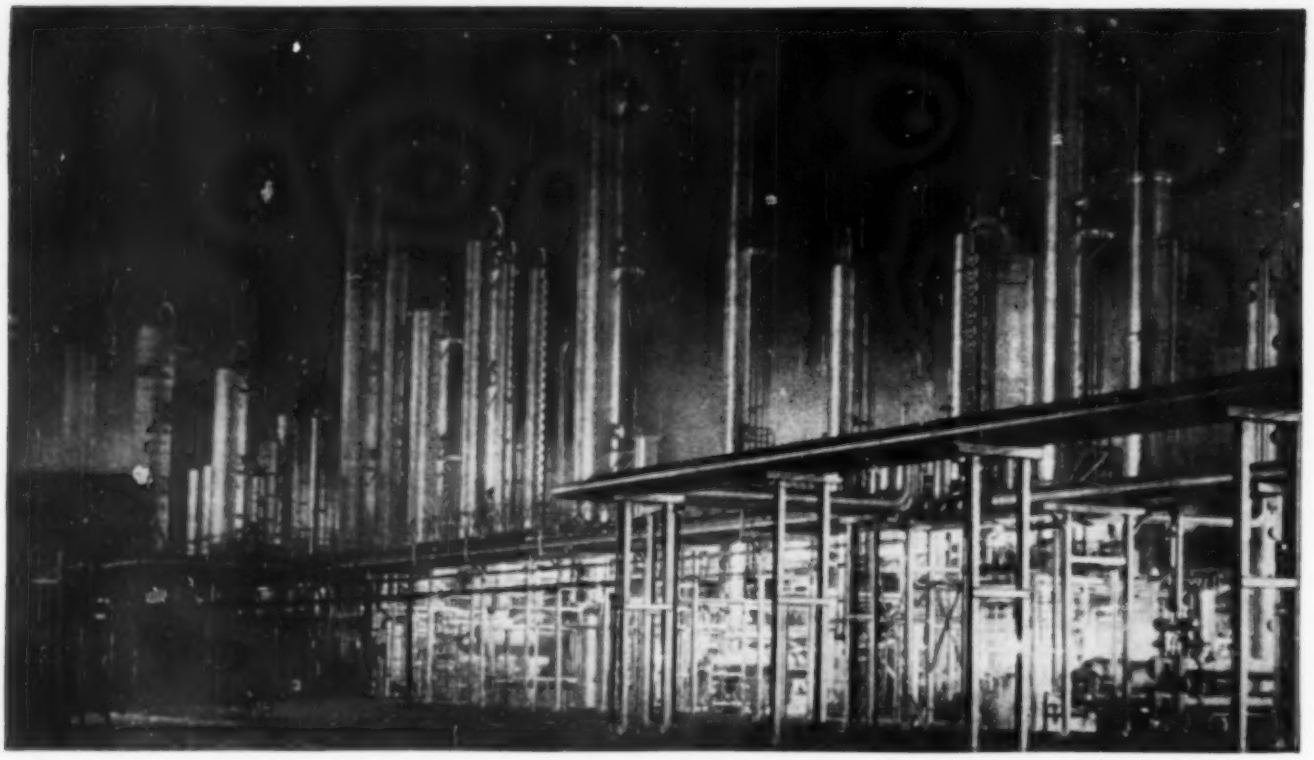
Machines

The program included modernization of the two fourdrinier paper machines. Improvements included anti-friction bearings, stainless-steel Betram head boxes, and 36-in. Neilsen slices, suction couch and first-press rolls, complete new drives direct-connected to the machines (prime movers on turbines). Along with these improvements are new paper rolls, for winding paper after calendering. Transite hoods over the machines, connected to vapor economizers, improve the quality of paper produced and increase efficiency of mill operation. An increase in the capacity of the machines of 40 percent has resulted from improvements in characteristics of the paper stock and improvements in the machines. The additional stock that has become necessary to keep the machines supplied has been met by the improved efficiencies in the de-inking process already mentioned. A great deal of care was used in the selection of materials and design of the head box in order to assure greatest possible uniformity of product.

All piping throughout the mill that comes in contact with either stock or water is galvanized iron, copper, Transite or stainless steel. Stock chests are tile-lined or solid tile construction. Machine trays and machine piping are largely copper or stainless steel.

New auxiliary equipment includes a multiple cutter with overlapping delivery which cuts ten rolls of paper simultaneously at a speed of 500 ft. per min. The finishing room is equipped with newest type of trimmers and other machinery. This room has been entirely air-conditioned.

The paper on which this article is printed was de-inked by the sodium peroxide process, coated by the microjet method, and otherwise prepared by the methods described here. The Newton Falls mill in which it was made not only uses this new process for de-inking but has modernized its entire operating procedures and equipment. It stands today as one of the most modern de-inking mills in the United States.



Butane-propane oxidation yields methanol as one of the primary products at this Celanese plant at Bishop, Tex.

Methanol Industry Makes Plans for the Future

ANTHONY A. WILLIAMS

Celanese Corp. of America, Chemical Division, New York, N. Y.

EXPANSION PLANS OF MAJOR PRODUCERS SHOW PROMISE OF MEETING THE CHALLENGE OF A RAPIDLY GROWING MARKET FOR SYNTHETIC METHANOL

Consuming requirements for synthetic methanol have been far ahead of production in recent years in spite of efforts of producers to work at near capacity rates. Growing demand for formaldehyde and antifreeze has been the largest factor in causing the shortage. Expansion projects scheduled for completion this year and next should bring a balance between supply and demand as producers carry out their long range plans to meet future requirements.

METHANOL has long been one of the synthetic organic chemicals in short supply. Meanwhile, industry's needs for this compound have also continued to grow rapidly. In 1948, two of the five present producers will greatly increase their facilities, and three new producers will enter the field giving a total increased capacity of over 40 percent of that on stream in 1947. Actual production in 1948 will be about 110 million gallons and is expected to create a close balance between supply and demand.

In 1949, capacity will be about 138

million gallons. Further expansion is probable up to 150 million gallons if and when Heyden Chemical Co. decides to operate its Morgantown plant.

Expanded anti-freeze requirements, increasing formaldehyde capacities and new applications in chemical processing and synthesis will supply an increasing market for this compound during the next few years. It must be borne in mind, however, that potential volume, as opposed to actual production this year will be in excess of the demand and any sudden acceleration of production during the next two years or slackening in the anticipated growth of demand could easily lead to overproduction. In all events, an easy supply of methanol can be expected by the end of 1948 and will continue well into the 1950s.

Relief of Shortage

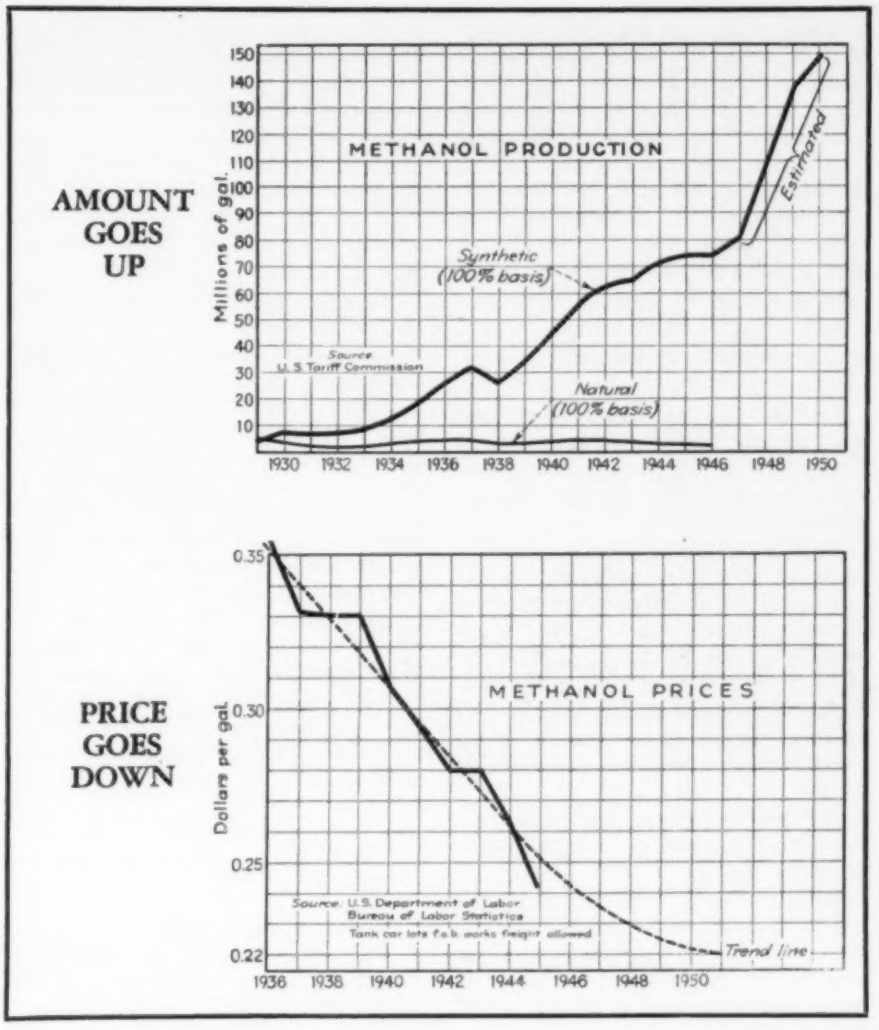
This sudden relief of what has long been an acute shortage could be expected to have certain effects on the methanol price structure, and in the long run prices probably will decline further. However, due to increasing costs of construction, production and transport, this does not seem likely at this time and present indications in the industry do not suggest any price reduction during 1948.

In 1924, Germany began commercial production of synthetic methanol, a step which revolutionized the future of this material and its derivatives.

In 1925, imports of the German synthetic product first entered the United States; these increased up to 1927 when they were 1,714,442 gal., or roughly 25 percent of the domestic production. By 1930, however, imports had fallen to 16,716 gal. and they have remained negligible since that time.

In 1926, E. I. du Pont de Nemours & Co. produced methanol by this method at Belle, W. Va., as a by-product of their ammonia production. In 1927, Commercial Solvents Corp. at Peoria, Ill., started to hydrogenate waste CO_2 gases from the butanol-acetone fermentation units. Later, in 1932, natural gas was substituted as the raw material for CO. These two alternative raw materials, CO_2 and CO, are still used. This company was the first in the United States to produce and market synthetic methanol, as Du Pont did not actually begin their large scale synthesis of methanol for sale until about 1930.

Carbide & Carbon Chemicals Corp. entered the field in 1929 employing the German method and in 1934 the Star Oil Co. (later Empire Oil and eventually absorbed by Cities Service) began producing methanol by the direct oxidation of natural gas (mainly methane). Although American Cyanamid Co. was reported to be producing methanol from 1941-43, this was of a purely byproduct nature and the volume was negligible. In 1946, Celanese Corp. of America began production as one of the primary products of its butane-propane oxidation process.



This rapid growth of methanol production is shown in an accompanying graph. The first estimate of production in 1929 was 4 million gallons. In 1945, total production had reached over 74 million gallons; no change was recorded in 1946; but 1947 output was 80 million gallons. At this time, there are five methanol producers whose combined capacity is 84 million gallons a year. This excludes non-operating government built capacity.

The two companies, Du Pont and Carbide, possess 90 percent of the country's operating synthetic methanol capacity; all producers are working as close to capacity as operating conditions will allow.

Although, at this time, only a very small percentage of the methanol output is produced from direct oxidation of natural or petroleum gases, an increasing quantity of the CO required for the alternative process is derived from this source. It is estimated that, in 1946, 71 percent of the CO used for methanol production was obtained from coal or coke; in 1948, 77 percent of this raw material will be derived from natural gas.

Although the country's operating capacity is 84 million gallons a year, actual production has never reached this figure. Labor troubles in the coal and steel industries during the spring

Present Methanol Producers

Company and Location	Method of Production	Raw Material
Carbide & Carbon Niagara Falls, N. Y.	$CO + H_2$	Coke
Carbide & Carbon S. Charleston, W. Va.	$Co + H_2$	Gas
Celanese Corp. Bishop, Tex.	Oxidation of butane and propane	Gas
Cities Service Tallant, Okla.	Oxidation of natural gas (CH_4)	Gas
Commercial Solvents Peoria, Ill.	$CO + H_2$ or $CO_2 + H_2$	Gas
Du Pont Belle, W. Va.	$CO + H_2$	Coke

of 1946 resulted in an acute shortage of CO from coal and coke which caused a drop of methanol output, in May, of approximately 80 percent. Again in 1947, an accident in the plant of a major producer caused a loss of production which will not be fully regained this year. Demand is far in excess of present capacity figures, and new installations are necessary to relieve an extremely tight situation.

Sources of Demand

Demand for methanol is greatest from the anti-freeze market and from formaldehyde producers who either serve, or are engaged in, the thermosetting resin industry.

Anti-freeze production and sales for all types (methanol, ethanol, iso-propanol and ethylene glycol) for the past three seasons are estimated, in the absence of accurate data, as follows: 1944-5, 62.0 million gallons; 1945-6, 53.0 million gallons; and 1946-7, 70.0 million gallons. It is probable that a similar volume will be available for 1947-8.

For anti-freeze purposes at prevailing prices, consumers prefer methanol. Ethylene glycol is second choice and ethanol is third. Iso-propyl alcohol is not considered to be a serious factor due to its higher freezing point, except, as at the moment, in times of acute shortage when it can be mixed with methanol and so extend the supplies of the latter. Ethanol, due to its high price, is not popular and has been used during the last few years only because of the lack of methanol and ethylene glycol. Currently roughly 30 percent of anti-freeze distributed is methanol. Other types are divided 20 percent to ethylene glycol and 50 percent to ethanol. Iso-propyl is confined mainly to methanol mixtures in order to further the availability of the latter.

With increased supplies of glycol and methanol, ethyl alcohol will undoubtedly decline in importance in this field and a 35-65 percent division is expected between glycol and methanol if current prices prevail.

This indicates that present demand for methanol is at least 45 million gallons, or over 55 percent of that currently produced. This figure is more than the quantity of methanol which found its way into anti-freeze before the war, but there is no reason why the old percentage (38 percent) will not be reinstated as production of methanol and ethylene glycol increase. If glycol prices are reduced with increased production, it probably will divide the anti-freeze market equally with methanol. No indications of glycol price reductions are evident as yet, but production capacity has recently been completed by Wyandotte and further supplies are due shortly from Du Pont and Jefferson Chemical. This expansion, together with the increased methanol production which will come next year, should mean that much less reliance upon ethanol and iso-propanol will be necessary in 1948-9; this is emphasized by the customer preference noted above.

Assuming a total present anti-freeze demand of 85 million gallons, this indicates a necessary production of 112 million gallons of methanol if glycol prices are sufficiently reduced during 1948 to effect an equal division of the market between these two compounds. If, however, glycol prices remain firm during next year, total methanol output will need to be 134 million gallons. This demand will continue to grow rapidly for two to three years and may attain some 100 million gallons, which will require a total methanol output of between 125 million and 160 million gallons a year dependent upon glycol price movements.

Formaldehyde Manufacture

Second main end use for methanol is for manufacture of formaldehyde. Before the war, approximately 40 percent of the methanol output went to this use, and this figure still holds. Due to the high industrial demand for formaldehyde, and hence for methanol, it is probable that this situation will continue. Based upon potential formaldehyde capacities in 1947, the annual methanol demand is 45 million gallons of which only slightly over 30 million are now available. This shows that formaldehyde derived from methanol is being produced at only about 66 percent of actual capacity.

In addition to this present unsatisfied demand, new formaldehyde plants are either being built or considered by major consumers; among these are Durez Plastic and Chemical Co. and Casein Corp. who already are in partial operation, Monsanto, Reichhold and Du Pont (additional plant). Actual present and planned formaldehyde plants give a potential of over a billion pounds for 1948, although actual production will depend on availability of methanol. Beyond this are those companies who, as yet, have no plans for production, but are seriously considering the possibility, such as the American Cyanamid Co.

As most of this formaldehyde will be produced by the oxidation of methanol, there will be a demand of over 60 million gallons of methanol a year. To maintain the present and, in the past, always a reliable end use percentage (40 percent of the methanol output of formaldehyde), total methanol required in the United States would be 150 million gallons a year. So great an increase in formaldehyde production will not occur all at once and probably will not be attained for a few years. Nonetheless, a production of 750-800 million pounds of formaldehyde (only slightly above present plant capacity) is dependent only upon the availability of methanol.

If the end use percentage remains the same, total methanol requirements will rise to 125 million gallons a year during the latter part of 1948, and will be 150 million gallons in a few years. As over 80 percent of the formaldehyde output goes into thermosetting resins, this assumes a sustained demand in the plastic field.

For the inhibition of formaldehyde to prevent polymerization during shipment or storage, approximately 3 million gallons of methanol will be needed in 1947; this will be 3.5-4 percent of the methanol available. Anticipated formaldehyde production will require a corresponding increase in the use of methanol for this purpose.

General solvent uses account for 8-10 percent of present production. Although this use is growing, it is not doing so to a great degree and will decrease on a percentage basis. Similarly, denaturant uses are small (5 percent) and, percentage-wise, likely to diminish, especially as natural methanol is preferred for this purpose.

Chemical synthesis and processing, on the other hand, while small in percentage, can be expected to grow as methanol becomes more readily available. New uses are being uncovered which await only a free supply to be exploited on a commercial scale. These uses which now comprise only about 5 percent of the methanol used and will probably double or treble on a percentage basis and so offset the lesser rate of expansion expected from solvent and denaturant demands.

Summarizing the end use pattern developed above for 1947 which is in general agreement with prewar years, we have:

Percent by Volume	
Anti-freeze	38
Formaldehyde	40
Inhibition of formaldehyde	4
Solvent	8
Denaturant	5
Synthesis and processing	5

There is no reason to expect any fundamental changes in this structure. Anti-freeze, formaldehyde production

and the inhibition of formaldehyde are expected to remain the same on a percentage basis and their certain growth constitutes the main reason for expanding demand. Solvent and denaturant uses will grow, but at a slower rate and, accordingly, their percentage will fall. Special processing and synthesis will grow and the extent of this growth will compensate for the percentage losses of denaturant and solvent uses.

It is estimated that total demand for synthetic methanol is now about 120 million gallons a year and will, within the next two years, reach 125-135 million and may attain 150 million gallons in three to five years. These goals are dependent first, upon the growth of the anti-freeze market and the portion thereof that methanol can hold; second, upon a sustained formaldehyde demand, and third, upon the rate of development of new uses in the field of chemical synthesis and processing.

Increased methanol production is dependent upon new facilities. Of the five companies operating today, two, Commercial Solvents and Du Pont, are completing new plants at Stirlington, La., and Orange, Tex., respectively. In addition, two new producers, Solvay Process at South Point, Ohio, and Spencer Chemical at Military, Kan., are entering this field for the first time.

Commercial Solvents is trebling its original capacity and will use CO and H_2 derived from natural gas. Du Pont is constructing a new plant of approximately the same capacity as its original installation at Belle. However, instead of doubling present methanol production, it is believed that certain units at Belle will be converted to ammonia production for the urea expansion program while others will be retained to supply requirements of the formaldehyde operations at this location and also an approximately equal quantity for other uses in their own plant operations. These operations in Texas will be based upon natural gas.

Solvay and Spencer

Solvay and Spencer operated government-owned ammonia plants during the war and now are completing their partial conversion to methanol production. Solvay derives its raw materials from coke and Spencer from gas. Due to the government's great demand, and its regulations, for the continued production of ammonia for the fertilizer trade, these conversions are only a small part of the total plant capacity available for conversion. Their total production of roughly 22 million gallons will be sold in the chemical market as these operators have no methanol requirements of their own at this time. Similarly one third of Commercial Solvent's output is expected to be available for relieving such shortages as anti-freeze. Du Pont, on the other hand, will undoubtedly consume its increased production through its own formaldehyde and anti-freeze operations. There is one other new producer, McCarthy Chemical Co., which is scheduled to produce methanol in 1948.

New Capacity

Total new capacity is estimated at 56 million gallons, giving the country a total capacity of 138 million gallons in 1948. All these units are expected to be on stream in the first quarter of 1948, but not at capacity until late in the year. Impact of increasing the country's capacity by 40 percent in one year is therefore, not likely to be felt immediately.

Probably 50 percent of this new capacity will be realized in 1948 and 100 percent in 1949. Total production for 1948 will be, therefore, 105-110 million gallons and 130-140 million in 1949.

In round figures, this seems to approximate fairly well the estimated demand for the next three years and, over this period, the demand seems to be balanced from year to year. This balance will be very fine and any acceleration in production, or lag in demand during the next few years could result in overproduction.

The 1948 capacity for production should be able to carry the total requirements of industry for methanol well into the future. For competitive reasons, and also due to the world's urgent need for fertilizer, there is no cause to examine the position of government built ammonia plants. The possibility of further conversion of these is too unlikely and certainly too remote for present consideration. The only possible exception is the case of the Du Pont built and (post-war) Heyden operated plant at Morgantown, W. Va.

This plant was constructed for methanol production on the largest scale known to date; it has an estimated capacity of 70-80 million gallons a year. It is not likely that this plant will be operated at capacity due first, to its magnitude (from an economical production point of view) and second, from a market standpoint because of the large disturbances in the whole methanol market which the sudden influx of only a portion of this potential volume would make.

From a long range point of view, however, there is a very distinct possibility that it may go into partial production. The reason underlying this is that Heyden is one of the two largest formaldehyde producers in the United States and they are not basic in their raw material, methanol. This plant consists of a series of methanol units and the company may operate either one or two of them to satisfy its own needs.

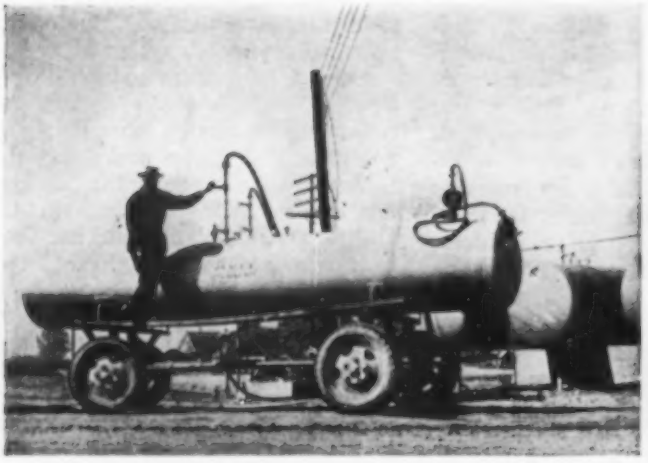
Such a move would not affect this company itself from a competitive market standpoint as it would merely relieve it of the necessity of purchasing this material from Du Pont and others. The effect on the chemical market, however, would be as great as if this quantity were offered for sale.

There is one other source of methanol supply: Fischer-Tropsch. This is not likely to be worthy of serious consideration as the Fischer-Tropsch processes are not, so far as their operation is currently planned, conducive to production of single-carbon-atom compounds; actual production is estimated at less than a ¼ million gallons a year for both the Kansas and Texas plants combined.

Prices

Methanol price trends over the last twenty years have been continually downward, as is shown in an accompanying graph; this graph is based upon annual average figures compiled by the Department of Labor, Bureau of Labor Statistics. With the exception of the first few years of synthetic production the trend line is remarkably clear and has been included.

There has been, to date, no indication of prices levelling off although it is very possible this may be taking place. The change from coal and coke derived CO to natural gas effects a lowering of raw material costs for certain producers, it is true; but this is offset by the distance of natural gas sources from the methanol markets and increased freight rates involved place serious limitations on further price reductions. Increasing price of coal also raises the cost of production for companies who use this material as a source of CO. Before the war, it was probable that the price of methanol would eventually fall to around 20-21 c. a gallon (f.o.b., freight allowed basis). At present, however, due to the increased costs noted above, it is unlikely, if at all possible, that prices can drop to this level under present production techniques.



FIELD TRANSPORT TANK takes on anhydrous ammonia from bulk filling station before a truck hauls it to field

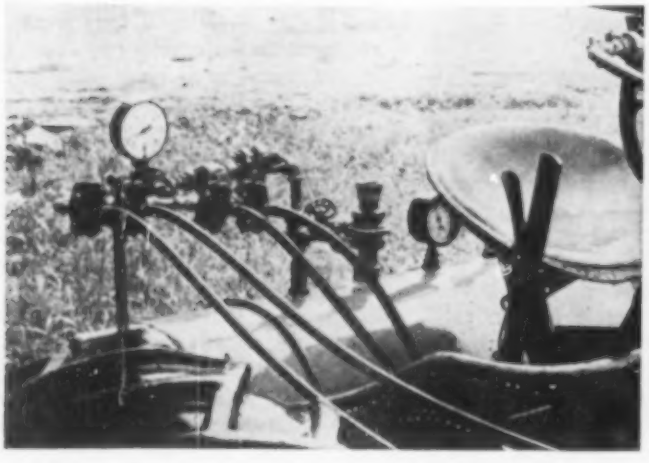
PICK-UP TRUCK pulls trailer-mounted anhydrous ammonia tank over the road from filling station to farmer's fields

DOWN ON THE FARM—

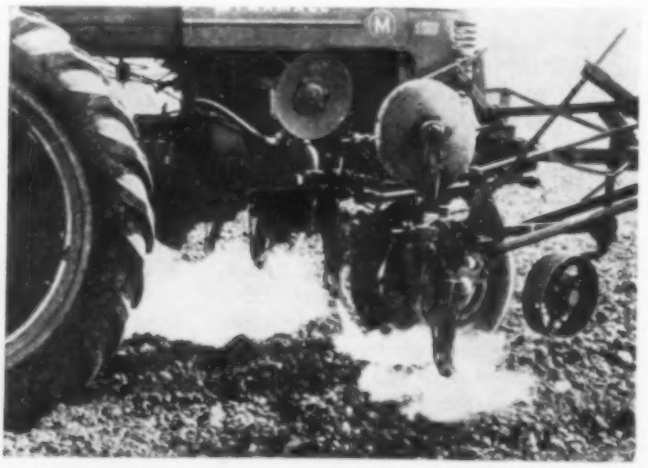
CHEAPEST SOURCE OF FERTILIZER NITROGEN IS NOW AVAILABLE TO U. S. FARMERS FOR DIRECT APPLICATION TO GROWING CROPS

Latest development in the fertilizer field may be a boon not only to the nation's farmers but also to ammonia producers. For a tremendous new market for ammonia may be created by its successful application directly to crops in the soil. Last year more than 200,000 acres of corn and cotton were fertilized with anhydrous ammonia. Aqua ammonia is just as good. Use of ammonia by farmers started in the Mississippi delta, spread through the South and is now moving into the Middle West. Ammonia is a big dollar-saver for thrifty farmers.

DIRECT application of ammonia to crops may open a tremendous new market for ammonia producers. The nation's farmers are climbing on the ammonia fertilizer band wagon. Both anhydrous and aqua have been used successfully. Ammonia has one big advantage over other nitrogen fertilizers. It is the cheapest source of nitrogen available. That is why its use has spread from the Mississippi delta through the South and even into the Middle West. Ammonia can be transported cheaply.



VALVE regulates ammonia flow from tractor tank to orifices in manifold. Rubber hoses connect manifold with applicators



APPLICATORS raised from ground for inspection emit fog of ammonia indicating that hose lines and orifices are clear

BLEEDING transfers anhydrous ammonia from trailer tank to small tank on tractor-distributor which does the fertilizing

TRACTOR-DISTRIBUTOR employs applicators and sweeps to put down anhydrous ammonia in a cotton side-dressing job

Ammonia Gets a New Chore

Besides, it is easy for the farmer, using simple machinery, to apply ammonia. A tractor-distributor has to refill less frequently when applying ammonia than when applying any other material. If he prefers, the farmer can get his ammonia put down by a service agency. The ammonia can be distributed at a uniform rate and at a desired depth. And crops respond to ammonia fertilizer. But there is one problem to lick. That is the cost and scarcity of storage equipment.

In Gaseous State

At atmospheric pressure and normal temperatures ammonia is a gas. It is compressed to a liquid for handling in commerce. It exists as a liquid below −28 deg. F., and it boils at this temperature. At 50 deg. F. it has a pressure of 75 psi. At 100 deg. F. it has a pressure of 197 psi. The pressure is about the same as that for commercial propane, which is used for flame cultivation, and anhydrous ammonia may therefore be handled in propane equipment. Anhydrous ammonia may be diluted with water to give a 30 percent ammonia solution. This solution has no pressure except at high temperatures.

When applied to the soil, ammonia combines with the clay and organic matter to form solids. It is necessary that ammonia be covered as it is applied. This prevents its loss into the air. So long as nitrogen in the soil is in the ammonium form it is not leachable.

In fertile, well-aerated soils ammonia is converted into nitrates within four to six weeks in warm weather. The rate of nitrification is slower in poor soils, wet soils and heavy soils. It is also slower during cold weather.

Anhydrous ammonia and aqua ammonia have equal value for crop production. The determining factor in choice is cost applied to the land. The elements determining cost are: (1) wholesale price, (2) freight, (3) retailer's margin, (4) storage costs, (5) local transport costs and (6) cost of application. With a given set of conditions, the approximate cost of anhydrous and aqua ammonia may be calculated. However, the use of both is so new that the storage and distribution pattern has not been established. It is probably entirely safe to say that anhydrous ammonia was cheaper last year than aqua ammonia could have been.

Nitrogen from ammonia costs less than nitrogen from any other source. At the present time relative retail prices of nitrogen are approximately those given in the accompanying table.

Source of Nitrogen	Cents per Pound of Nitrogen
Anhydrous ammonia	6
Ammonium nitrate	10
Cyanamide	13
Sodium nitrate	17

The retail price of nitrogen as anhydrous ammonia may advance to 7.3c. per lb. during 1948. Cost of anhydrous ammonia in the future will depend upon the length of the storage period. This, in turn, will depend upon demand and seasonal use.

Over 200,000 acres of corn and cotton were fertilized with anhydrous ammonia during 1947. It has also been applied successfully to such crops as oats and sugar cane. Its application to rice is now being studied. The use of anhydrous ammonia moved quickly into the delta of Arkansas and Louisiana, and it is now spreading into the hill sections of Mississippi. It is getting a start in Alabama, Florida and some states in the Middle West. About 160,000 lb. of nitrogen as ammonia was applied to about 4,000 acres in Louisiana in 1946. It is being used in the northeastern cotton area around St. Joseph, La., in the northwestern cotton area around Shreveport, La., and in the southern sugar cane area around Thibodaux, La., and Reserve, La. Most of the 200,000 acres of row crops fertilized with anhydrous ammonia last year were in Mississippi. The acreage which will be fertilized with anhydrous ammonia this year promises to run into the millions.

Ammonia is transported to the field in a 1,000-gal. propane tank. This is mounted on a trailer and hauled by truck. At the field, the ammonia is transferred to a 100-gal. propane tank mounted behind the driver's seat on a tractor-distributor. When the operator is fertilizing a row, the flow of ammonia from the tank through the orifices in the manifold is controlled by a regulating valve. Rubber-hose feed lines run from the manifold to the steel applicators. These feed lines are ¼-in rubber air hose tested to 150 lb. The hoses are clamped to the applicators. Applicators have a leading knife-edge. They are curved and pointed. Pulled through the ground

at a depth of 4 to 6 in., the applicators open up the soil. When used, disc hillers are mounted behind and above the applicators at about half the depth of the applicators. This insures complete sealing of the ammonia in the ground. Sweeps and other plows are also used as covering devices. Most of these tractor-distributors are presently supplied by the Finklea Implement Co. of Lealand, Miss. Ammonia is applied either as a water solution containing about 23 percent nitrogen or as a gas containing 82 percent nitrogen.

Valves and Fittings

Before propane storage and tractor tanks can be used for handling anhydrous ammonia it is necessary to change the bronze valves and fittings employed with propane to special iron or steel valves and fittings. All storage and tractor tanks and fittings must withstand a 250-psi. working pressure.

Farm storage tanks may be mounted permanently or they may be mounted on trailers or a combination may be used. At present, the most commonly used storage is 1,000-gal. tanks mounted on trailers. The tractor-mounted tank is customarily of 80 to 110 gal. in capacity.

The same type fittings are used on storage and tractor tanks. Fittings for the tanks include: (1) 300-psi. gage; (2) bleed-off valve with stationary-fill depth pipe in tank; (3) vapor-return valve for filling with pump or compressor; (4) pop-off valve; (5) liquid-inlet filling valve; (6) liquid-outlet feed valve connected to down-pipe equipped with strainer and (7) standard glass gage.

Anhydrous ammonia is metered by means of a differential pressure regulating valve, or by means of a needle valve and pressure gage. The pressure gage setting varies as the tank pressure varies. The desired rate of application of nitrogen from anhydrous ammonia is obtained by adjusting the regulating valve for the tank pressure and tractor speed. In experimental work, anhydrous ammonia is metered by a rotameter. Aqua ammonia is metered by a metering pump geared to the tractor.

Present tractor-distributors are equipped with either a differential pressure regulating valve or needle valve and pressure gage for metering or regulating the flow of anhydrous ammonia through orifices in the manifold. A short nipple connects the tank feed-line valve to a quarter-turn cut-off valve which is connected to the regulator valve. The manifold connects to the low-pressure side of the regulator valve. The regulator valve is built to take 250 psi. on the tank side and 100 psi. on the manifold side. The manifold is made of short tees, elbows and anhydrous ammonia flange unions into which the orifices are fitted.

When one applicator is used per row the size of the orifices is ⅝ in. When the application is made with middle busters, or other equipment where two applicator furrows are made per row, the orifices feeding these lines should have one-half of the area and not one-half of the diameter of ⅝-in. orifices. The diameter of the one-half sized orifice is approximately ⅜ in.

Aqua ammonia normally has negligible pressure. This makes it possible to use a lower pressure metering pump to meter the material to the applicators. The type of pump used is a 20 DV Yale-Towne rotary positive-displacement pump with variable-volume manual control that will normally give 1.5 gal. per 100 rpm.

Pump Drive

This pump is driven from the tractor axle through a counter shaft which steps the speed up to 400 rpm. A 1¼-in. liquid line connects the pump to the tractor tank on the suction side of the pump. There is a 5- to 10-lb. pressure-relief discharge valve. The valve is used to cut off the small flow of liquid through the pump when the tractor is standing still. Connected to the pressure-relief valve is the manifold built from ¼-in. by 2-in. pipe nipple, with ⅝-in. orifices installed into ¼-in. ammonia flange unions. The top of the cap of the union is turned out ¼ in. deeper to take the orifice. The other side is threaded so that the orifice can be screwed into it. The ¼-in. 150-test rubber hose connects the manifold to the same type of applicators as previously described, and disc hillers are used for covering when the equipment is mounted on the tractor with the cultivator. Size of orifices has to change for different hook-ups.

When a metering pump has been developed to operate under high-pressure ammonia, and suitable for mounting on a tractor, anhydrous ammonia may be applied in a manner similar to aqua ammonia. The one great advantage of the metering pump is that the rate of distribution is timed with ground speed of the tractor.

Rate at which ammonia flows through the orifices depends upon the tank pressure. After the rate of ammonia per hour has been determined, it is necessary to determine the pressure at which the regulating valve must be set to give the desired pounds of ammonia. Manufacturers calibrate with a rotameter the equipment which they build. The size of the orifices and the pressure shown by the regulating valve determine the rate of flow of ammonia.

A farmer pays between $250 and $400 for the tractor equipment needed to put the ammonia in the soil. He pays between $500 and $600 for the 1,080-gal. trailer tank used to transport the ammonia to his fields. The tractor tank and trailer tank are used for propane. Propane is employed in flame cultivation.

The 1,080-gal. trailer tank, which may be pulled behind a pick-up truck, can hold 4,100 lb. of nitrogen, equivalent to 25,600 lb. of sodium nitrate. This is enough to fertilize 102 acres at 40 lb. per acre.

The tractor tank, which may be mounted on medium or heavy tractors, holds 100 gal. of ammonia, containing 410 lb. of nitrogen, which is equivalent to 2,560 lb. of sodium nitrate. At 41 lb. per acre, this is sufficient for 10 acres.

With the equipment available, farmers can apply anhydrous ammonia with one man and a tractor to about twice as many acres as can be fertilized by two men and a tractor with solids. A four-row tractor with one operator may apply nitrogen as anhydrous ammonia to from 40 to 80 acres per day, depending upon the tractor speed and the total daylight hours. The ammonia is covered when it is applied. Two men with a tractor normally apply solid fertilizer to 20 to 25 acres per day; however, the acreage covered may reach 40 acres per day with some present equipment. In most cases solid fertilizers have to be covered in a separate operation.

A considerable acreage was fertilized with anhydrous ammonia on a service basis in 1947. With a 40-lb.-per-acre rate of application, the service charge, in addition to the retail price of the nitrogen, was $2.60 to $3.60 per acre, which included hauling the ammonia. The total cost of the nitrogen applied was 12½ to 15c. per lb. The cost of equipment involved was $2,000 to $2,500.

If a tractor covers 40 acres per day, the income is $104 to $144 per day. This is probably more than the trade will tolerate under competitive conditions. If ammonia were applied for the difference between the cost of nitrogen as ammonia and ammonium nitrate, the cost for application of 40 lb. per acre would be $1.60 per acre, or $64 for 40 acres. This appears to be a good income for the equipment involved.

Uniformity of application is much greater than is usually obtained with

solids. It is estimated that a careful operator may maintain the rate of application within a plus or minus 5 percent during 95 percent of the time without taking undue precautions.

Depth of application is limited only by the height of lift of the applicators. When applied with the applicators attached to the cultivator frames, a 6-in. depth is the practical limit.

Anhydrous ammonia has been applied in a single operation on bedded or flat land before planting and in side-dressing crops. It has also been applied in combination with listing land before planting.

In experimental work both anhydrous and aqua ammonia have been found to have crop-producing value equal to, or superior to, ammonium nitrate for such row crops as cotton and corn. In dry years ammonia applied at depths between 4 and 6 in. is superior to surface-applied ammonium nitrate for these crops. This is attributed to positional availability. Ammonia may be applied at these depths more easily than can solid sources of nitrogen. Ammonia has been used widely enough to have proved itself a desirable fertilizer for cotton.

For such small grains as oats ammonia is a good source of nitrogen. It appears that ammonia applied in the fall will be superior to ammonium nitrate for production of both forage and grain. More nitrogen is applied in the fall than is used by early winter. The superiority of ammonia over ammonium nitrate is probably due to a better carry-over of unnitrified ammonia. In soils with a pH of 5 or less, where the rate of nitrification is slow, fall-applied ammonia is a good source of nitrogen. It will increase the yield by about 28 bu. of oats per acre. Where the rate of nitrification of ammonia is slow, the soil is able to retain the ammonia until spring; where the rate of nitrification is high (pH of 5.5 or higher), much of the ammonia is apparently converted into the nitrate form which is subject to leaching. It has been found that fall-applied nitrogen prevents heaving of oats. Difficulties in covering may limit use of ammonia in the spring on fall-planted small grains.

Ammonia has been used enough on the heavier soils to prove its value as a fertilizer for sugar cane. The Louisiana Agricultural Experiment Station is cooperating in experiments on sugar cane at Reserve, La., and it is conducting experiments with rice at Crowley, La. The Spencer Chemical Co., the Lion Oil Co. and Godchaux Sugars, Inc., are working with the Louisiana Agricultural Experiment Station on ammonia fertilizer experiments.

Unrefrigerated tanks for storing and transporting anhydrous ammonia require a working pressure of 200 to 250 psi. Provisions for shading, sprinkling or insulating are needed in extremely hot weather. Provision must be made for the necessary safety features. Hortonspheres are probably the cheapest containers for storage of large quantities of anhydrous ammonia. Aqua ammonia tanks require a working pressure of 10 psi.

Aware of the great reduction in nitrogen fertilizer cost that direct application of ammonia to the soil promised, the Mississippi Agricultural Experiment Station in 1943 started to determine crop response to ammonia as a source of nitrogen. The research program, supported jointly by the Mississippi Station and the Tennessee Valley Authority, included development of suitable equipment for applying ammonia to the soil, laboratory studies on the behavior of ammonia in the soil and measurements of the efficiency of ammonia in terms of crop yields. Results of experiments conducted during the past four years demonstrate that ammonia is a good nitrogen fertilizer when it is properly applied.

The information contained in this article was secured from the three following sources: (1) "The Use of Anhydrous Ammonia as a Source of Nitrogen," a paper presented by Dr. W. B. Andrews, associate agronomist at the Agricultural Experiment Station, Mississippi State College, State College, Miss., to the fall meeting of the National Fertilizer Association held in Atlanta, Ga., Nov. 10-12, 1947; (2) "Ammonia as a Source of Nitrogen," by W. B. Andrews, F. E. Edwards and J. G. Hammons, Mississippi Agricultural Experiment Station Bulletin 448, 1947; and (3) a private communication, dated Oct. 24, 1947, from M. B. Sturgis, head of the agronomy department at the Agricultural Experiment Station, Louisiana State University, Baton Rouge, La.

Nuclear Engineering Defined

NUCLEAR engineering will be an important future field of specialization, but one which requires of the engineer a reorientation in the order of magnitude of his thinking and a clear visualization of new concepts.

Paradoxically, nuclear engineering is not particularly interested in nuclear power. As long as this power has to be obtained through the path of heat, which is the case in the present state of scientific knowledge, there are plenty of engineers well versed in power plants, turbines and the like, to design the power machinery. The duty of the nuclear engineer, insofar as he is a specialist, could end therefore with the method of producing the desired temperature level in a satisfactory heat transfer medium. The nuclear engineer will be more interested in power production itself when and if science evolves methods of usefully releasing nuclear energy by means which do not involve a heat cycle.

The scope of nuclear engineering might therefore be defined as the design, construction and operation of nuclear reactors to produce power or useful radioisotopes, or radiochemical plants to recover the fuel or byproducts, and of waste storage and disposal systems.

New concepts which the nuclear engineer must grasp are:

1. Magnitude of nuclear energies. Expressed in engineering terms, one gram of mass is equivalent to about 25 million kilowatt hours.

2. Statistical character of work in the field of nuclear physics. An atom, and in fact matter, is made up largely of space. Any nuclear reaction requires that close contact occur between two nuclei.

3. Particles of nuclear physics pass relatively freely through the wide open spaces in the atoms of matter.

4. Restriction placed by nuclear physics on the materials of construction permissible in a nuclear reactor.

5. Short time element required in nuclear reactions. If for example, a pile designed to operate at 10,000 kw. should get out of control with an excess multiplication constant of 0.10, it will be at a level of 27,000 kw. in 0.01 sec.

6. Main cause of the difficulties in nuclear engineering is radioactivity. One whole phase of the problem deals with the interaction of radioactive particles with materials of construction, such as physical properties, heat evolution, etc. Another important phase is the insidious character of radioactivity. It tends to pass through "solid" matter for relatively long distances; it can escape directly through the smallest of apertures; or it can scatter in any direction after a collision. Each radioactive element or isotope, once formed and not subject to any further bombardment, loses its activity at a very specific rate and nothing known to science can speed or slow that rate. Furthermore neutrons, after travelling some distance through a material can induce secondary reactions which may emit high energy radiations at a point far out in a shield.

Based on a paper presented by John R. Huffman, Clinton Laboratories, before American Society of Mechanical Engineers, Atlantic City, Dec. 2, 1947.

Process Engineer's Guide to the Centrifugal Compressor-IV

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THIS ARTICLE DEALS WITH FLUID HEAD, COMPRESSOR CAPACITY, ADIABATIC AND BRAKE HORSEPOWER AND ACTUAL TEMPERATURE RISE

Earlier articles in this series appeared on pages 110-114 of our October issue, 132-135 of the November issue and 126-128 of the December issue. Whereas the earlier articles were concerned with air, other gases and gas mixtures without regard to compressor efficiency, the present article shows how to take account of the losses that occur in actual compressors in determining the actual head required, and the actual power consumption and temperature rise.

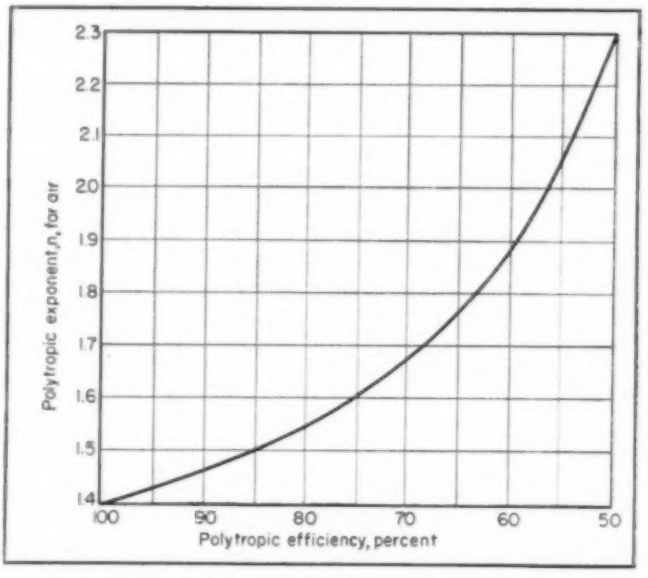

Fig. 1—Effect of polytropic efficiency on the polytropic exponent *n* for air

As has been stated in earlier articles of this series, it is generally the practice to rate centrifugal compressors on the basis of the adiabatic head required to produce the desired ratio of compression when handling a given gas under certain stated inlet conditions. This choice of the adiabatic head as a means of comparing or describing various installations is based on the desire to make such comparisons entirely independent of the efficiency of this or that particular machine, since the efficiency of a compressor does not enter into the computations of the required adiabatic head. At the same time, it must be remembered that a centrifugal compressor does not actually operate under adiabatic conditions.

Although a few machines have been built (mostly in Europe) with very effective intercooling between the consecutive stages to give an average compression curve with an exponent *n* somewhere between isothermal and adiabatic, such a construction has not yet been justified economically in the United States. Most centrifugal compressors operate uncooled, except between consecutive stage groups operating in series. Thus, the various losses which take place within the compressor, such as friction, turbulence, disk friction and leakage losses, are all transformed into heat and raise the temperature of the gas being compressed beyond that which might be calculated on the assumption of adiabatic compression.

As a result, the compression is not adiabatic, but polytropic, and the *n* exponent in the relation pv^n = constant (See Part I, Fig. 1) is greater than the value of *k*, or c_p/c_v.

The head which must be developed by the compressor is somewhat greater than the theoretical adiabatic head, and is defined as the fluid or polytropic head or that head which is required to develop a given ratio of compression under polytropic compression conditions. The term "fluid head" which is now tending to replace the previous term "polytropic head" is the more logical one to use, as it is easier to visualize, and emphasizes the close similarity between the theory of cen-

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trifugal compressors and centrifugal pumps. In reality, it corresponds to the term "total head" used in pump terminology. The only difference is that in the case of pumps, the required system head and total head of the pump coincide, since the inefficiency of the pump does not affect the density of the fluid handled and therefore does not impose a penalty on the head which the pump must develop. In the case of compressors, on the other hand, since the inefficiency of the machine changes gas conditions within the compressor, the fluid head is that head which must be developed by the compressor and is greater than the adiabatic head for the same pressure rise.

In so far as gases follow the perfect gas laws, the fluid head H_f can be calculated in exactly the same manner as the adiabatic head H_a, except for the substitution of the value n for that of k. Thus:

$$H_f = 144\ (n/n-1)\ p_1 v_1\ (r^{(n-1)/n} - 1)$$

or

$$H_f = R\ T_1\ (n/n-1)\ (r^{(n-1)/n} - 1)$$

also,

$$H_f/T_1 \times \text{spec. gr.} = 53.34\ (n/n-1)\ (r^{(n-1)/n} - 1)$$

Thus, if the polytropic exponent n is known, the fluid head H_f can be calculated from Figs. 1 and 2 of Part III (page 126, December 1947) in the same manner as we determined adiabatic heads for any given set of conditions.

Exponent Relationship

The relation between the polytropic exponent n and the adiabatic exponent k is:

$$(n-1)/n = [(k-1)/k] \times 1/e_p$$

where e_p = compressor polytropic efficiency. Neglecting the effect of the bearing losses—which, except in very few cases, do not affect the calculations materially—the polytropic (real) fluid efficiency of the compressor can be determined as:

$$e_p = e_a \times H_f/H_a$$

At first glance, it would appear that these two relations comprise part of a vicious circle. To determine the polytropic exponent n, it is necessary to know the polytropic efficiency e_p. The latter must be determined after computing the fluid head H_f which, in turn, is a function of n. However, it is possible to develop another relation which will express n in terms of the compression ratio r, the adiabatic exponent k, and the adiabatic efficiency e_a. The derivation of this relation presents no interest in our particular case and is therefore omitted:

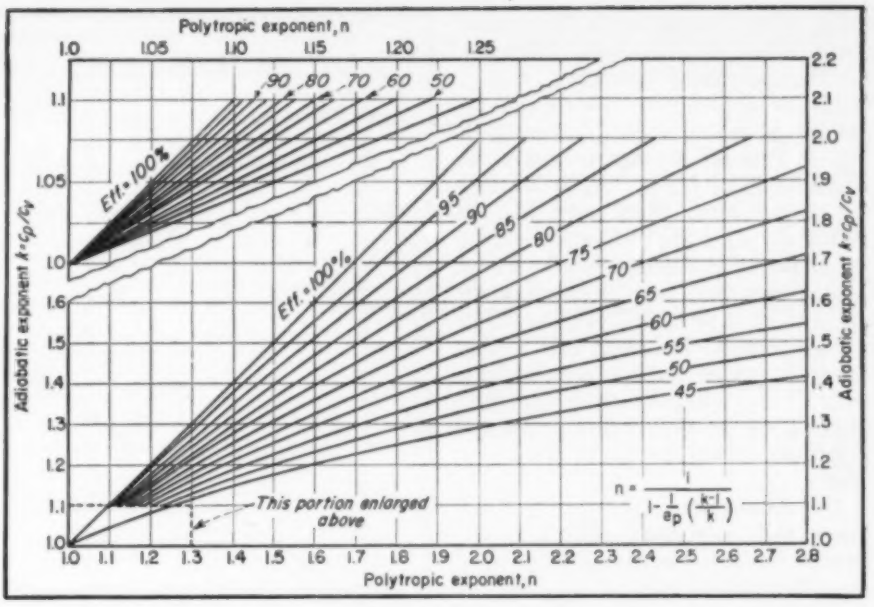

Fig. 2—Effect of polytropic efficiency on the polytropic exponent n for any gas

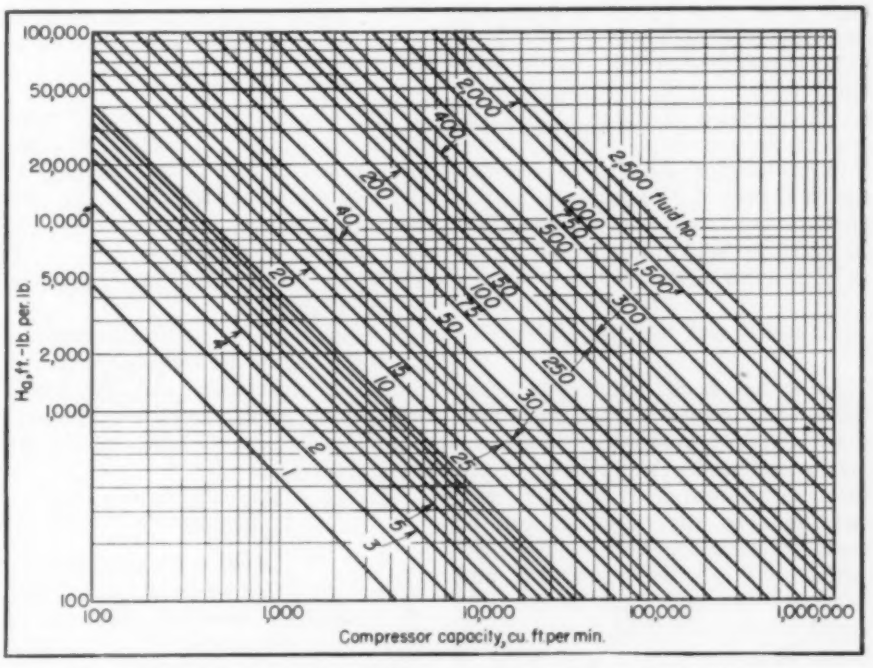

Fig. 3—Chart for determining fluid horsepower in terms of head and capacity required, based on air at 60 deg. F. and 14.7 psi. abs. inlet

$$\frac{n-1}{n} = \frac{\log\left[1 + (r^{(k-1)/k} - 1)/e_a\right]}{\log r}$$

While it would be possible to construct a chart to solve this relation, the use of such a chart would be rather tedious and is reserved for highly accurate calculations that may be required by compressor designers. It is possible instead to use an approximate solution for the exponent n. This short cut consists in substituting the adiabatic efficiency e_a, which is known, for the value of the unknown polytropic efficiency e_p. This substitution yields an approximation of the polytropic exponent n which is used in calculating an approximate polytropic head and finally a polytropic efficiency which is accurate within the limits of slide rule and chart-reading accuracy.

Fig. 1 gives a graphical solution of the relation between n and polytropic efficiency for air, while Fig. 2 shows the relation between n, k and polytropic efficiency for other gases.

For example, let us assume that the ratio of compression is 3.0, that the gas handled is air ($k = 1.3947$) at 80 deg. F. and that the adiabatic effi-

ciency of the compressor is 70 percent. Substituting this adiabatic efficiency for the polytropic efficiency, Fig. 1 yields an approximate polytropic exponent of $n_a = 1.68$. Referring to Fig. 1, Part III, we can calculate the adiabatic head H_a as 37,200 ft., and the approximate fluid head H_{fa} as 39,800 ft. Our approximation of the polytropic efficiency can now be made. The approximate polytropic efficiency $e_{pa} = 0.70 \times 39{,}800/37{,}200 = 0.749$ or 74.9 percent. Referring back to Fig. 1, we determine the actual value of n to be 1.615. Recalculating the fluid head H_f we get 39,400 ft. and the real polytropic efficiency $e_p = 74.2$ percent.

We should note right here that the lower the polytropic efficiency, the greater the increase in the value of n over that of k and, of course, the greater the increase in the fluid head over the adiabatic head. The deviation of the fluid head from the adiabatic head also increases with the compression ratio, as can be seen from Figs. 1 and 2, Part III. In the case illustrated above, the compressor must actually produce 39,400 ft. or 106 percent of the calculated adiabatic head. If in this example the ratio of compression had been 4.0 instead of 3.0, the adiabatic head would have been 48,900 ft. and the fluid head 52,400 ft. or 107.2 percent of the former.

Capacity and Specific Volume

As it has been stated previously, there exist several "standard conditions" to which compressor conditions may be referred. It should be noted that a conversion from any one set of conditions to any other set can be made very readily. Starting from the perfect gas law, $144\ pv = RT$, and selecting (a) and (b) as the subscript for two different sets of conditions, we have:

$$p_a v_a / T_a = p_b v_b / T_b$$

If, therefore v_a and v_b are the specific volumes at conditions (a) and (b) respectively,

$$v_b = v_a\ (p_a/p_b)\ (T_b/T_a)$$

In other words, the specific volume varies inversely as the absolute pressure and directly as the absolute temperature. For example, if the specific volume of air at 60 deg. F. and 14.7 psi. abs. is 13.094 cu.ft. per lb., then the specific volume at 3.0 psi. ga. and 90 deg. F. will be $v_b = 13.094 \times 14.7/(14.7 + 3.0) \times (460 + 90)/(460 + 60) = 11.5$ cu.ft. per lb. This relationship must therefore hold true as well for capacities handled by a compressor and is useful in determining changes in volume per unit of time at the various pressures and temperatures prevailing in a centrifugal compressor installation. Thus, where Q is capacity under conditions (a) or (b) in cu.ft. per min.

$$Q_b = Q_a\ (p_a/p_b)\ (T_b/T_a).$$

Examples of capacity corrections are given in Table I.

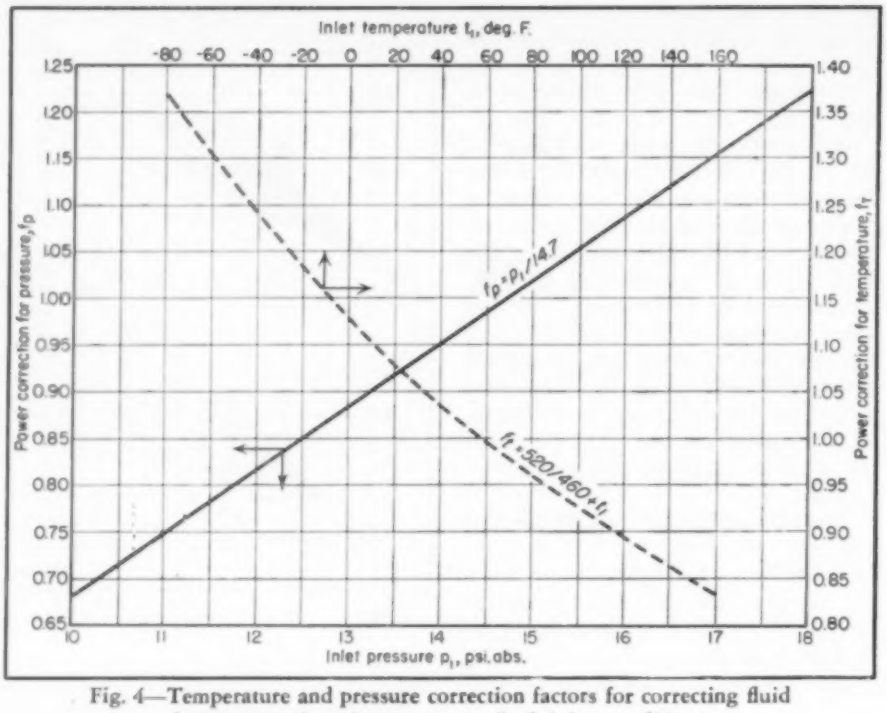

Fig. 4—Temperature and pressure correction factors for correcting fluid horsepower for air at non-standard inlet conditions

Efficiency of a centrifugal compressor is defined as the ratio between the adiabatic horsepower and the brake horsepower consumed by the compressor. The formula for adiabatic Hp. is:

$$\text{Adiabatic Hp.} = \frac{144\ p_1 Q_1\ (k/k-1)\ (r^{(k-1)/k} - 1)}{33{,}000} = H_a \times (Q_1/v_1)/33{,}000$$

where H_a = adiabatic head in feet; Q_1 = capacity at inlet conditions in cu.ft. per min.; and v_1 = specific volume at inlet conditions, in cu.ft. per lb. The numerator of the last expression represents the product of the weight of gas handled per minute and of the height to which it is raised.

If the gas in question is air, at standard suction conditions of 14.7 psi. abs. and 60 deg. F., when $v_1 = 13.094$, the formula becomes:

$$\text{Air Hp.}_a = H_a \times \text{Cfm.}/432{,}100$$

where Air Hp._a = air horsepower at 60 deg. F. and 14.7 psi. abs. suction.

The chart of Fig. 3 shows the adiabatic horsepower for air for a range of capacities from 100 to 1,000,000 cu.ft. per min. and a range of heads from 100 to 100,000 ft.

For any other inlet pressure and temperature conditions, the adiabatic air horsepower is given by the formula:

$$\text{Air Hp.} = \text{Air Hp.}_a \times f_t \times f_p$$

where $f_t = 520/(460 + t)$ and $f_p = p_1/14.7$. These corrections are plotted in Fig. 4. For gases other than air, the formula is still given by

$$\text{Adiabatic Hp.} = H_a \times (Q_1/v_1)/33{,}000$$

Examples of adiabatic horsepower calculations appear in Table II.

Temperature Rise

The temperature rise of a gas due to adiabatic compression is given by the following formula:

$$\Delta T = T_2 - T_1 = T_1\ (r^{(k-1)/k} - 1)$$

and

$$T_2 = T_1\ r^{(k-1)/k}$$

Since

$$H_a = RT_1\ (k/k-1)\ (r^{(k-1)/k} - 1)$$

the temperature rise can also be calculated from the formula:

$$\Delta T = H_a/[R(k/k-1)]$$

For air:

$$\Delta T = T_1\ (r^{0.283} - 1)$$

If the adiabatic head H_a for air has been established, it may be easier to calculate the theoretical temperature rise from the formula:

$$\Delta T = H_a/[R(k/k-1)] = H_a/188.48$$

The *actual* temperature rise, including the rise due to compressor inefficiency, is somewhat difficult to establish accurately, because bearing losses and radiation losses must be accounted for. However, a relatively close approximation may be obtained by the relation:

$$\Delta T_{\text{actual}} = \Delta T_{\text{theoretical}}/\text{Adiabatic eff.}$$

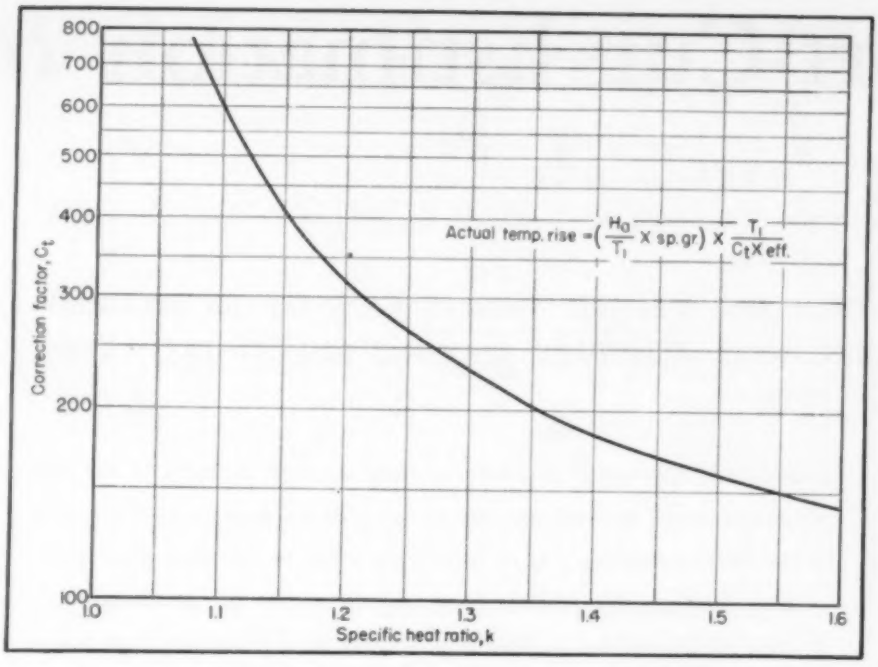

Fig. 5—Correction factor curve for determining actual temperature rise

Several examples of calculations for actual discharge temperatures are given in Table III.

Since the value of $(H_a/T_1) \times$ Sp.gr. is generally determined during the calculation of the adiabatic head H_a, Fig. 5 is also appended; it can be used to simplify the calculations of temperature rise in terms of this value, since:

Actual temp. rise =

$$\left(\frac{H_a}{T_1} \times \text{sp. gr.}\right) \times \frac{T_1}{C_1 \times \text{eff.}}$$

where H_a = adiabatic head, ft., T_1 = inlet temperature, deg. F. abs.; C_1 is a correction factor from Fig. 5; and eff. is adiabatic efficiency.

Conclusions

It must be remembered that all these concepts of adiabatic head and efficiency, or of fluid head and polytropic efficiency, are solely calculated, and not observed values. The test of a centrifugal compressor, operated at a given speed and under given inlet conditions, provides us merely with observations of discharge pressures and shaft horsepower. However, from these data, it is possible to calculate for any given inlet capacity and in the following order:

1. The ratio of compression r;
2. The adiabatic head H_a;
3. The adiabatic horsepower Air Hp.;
4. The adiabatic efficiency e_a;
5. The polytropic exponent n;
6. The fluid head H_f;
7. The polytropic efficiency e_p.

It must also be remembered that the methods indicated here do not take into account the compressibility factor of certain gases and that for a most exact and accurate calculation of the adiabatic heads and horsepowers of a number of hydrocarbons, especially in the range of higher pressures, correction factors need to be applied. It was not the intent of this article, however, to present such data but rather to present a clearer conception of the centrifugal compressor and of its field of application, as well as to introduce technical data necessary in the computation of certain application problems in a simpler and more useful form than heretofore available.

Table I—Compressor Capacity Calculations

EXAMPLE NO. 1

A centrifual compressor is to handle 10,000 cu. ft. per min. of standard air (at 60 deg. F. and 14.7 psi. abs.) and the inlet conditions are 100 deg. F. and + 10 in. of water column, barometer being 29.92 in. of Hg (14.7 psi. abs.). What will be the compressor capacity under inlet conditions?

Solution: $p_b = 14.7 + 10/12 \times 1/2.31 = 14.7 + 0.36 = 15.06$ psi. abs.
$Q_b = 10{,}000 \times 14.7/15.06 \times (460 + 100)/(460 + 60) = 10{,}520$ cu. ft. per min.

EXAMPLE NO. 2

A centrifugal compressor is designed to handle 15,000 cu. ft. per min. at inlet conditions of 0.5 psi. ga. and 80 deg. F. The discharge pressure of the compressor is 20 psi. ga. and the temperature at the discharge is 260 deg. F. What will be the compressor capacity at the discharge under these conditions?

Solution: $Q_b = 15.000 \times (14.7 + 0.5)/(14.7 + 20) \times (460 + 260)/(460 + 80) = 8{,}475$ cu. ft. per min.

Table II—Compressor Power Calculations

EXAMPLE NO. 1

What is the adiabatic horsepower for the compressor described in Example No. 1, Part II, if it is designed to handle 15,000 cu. ft. per min. at inlet conditions?

Solution: $H_a = 28{,}080$ ft.
Specific volume at 60 deg. F. and 14.7 psi. abs. = 13.094.
Specific volume at inlet = 13.094 × (460 + 80)/(460 + 60) = 13.6 cu. ft. per lb.
Adiabatic Hp. = 28,080 × (15,000/13.6)/33,000 = 938 Hp.

EXAMPLE NO. 2

What is the brake horsepower required to drive the centrifugal compressor described in Example No. 3, Part II, if it is designed to handle 5,000 cu. ft. per min. at inlet conditions and if e_a = 63.5 per cent?

Solution: $H_a = 3{,}672$ ft.
Specific volume of steam at 450 psi. ga. and 550 deg. F., from steam tables, is $v_1 = 1.21$ cu. ft. per lb.
Adiabatic Hp. = 3,672 × (5,000/1.21)/33,000 = 459 Hp.
B.Hp. = 459/0.635 = 724 Hp.

EXAMPLE NO. 3

What is the brake horsepower required to drive the centrifugal compressor described in Example No. 4, Part II, if it is designed to handle 20,000 cu. ft. per min. at inlet conditions and if the adiabatic efficiency is 71 percent?

Solution: $H_a = 20{,}450$ ft.
Specific volume of air at inlet conditions = 13.094 × 14.7/15.06 × 660/520 = 16.22 cu. ft. per lb.
Specific volume of flue gas at inlet conditions = 16.22 × 28.95/31.0 = 15.15 cu. ft. per lb.
Adiabatic Hp. = 20,450 × (20,000/15.15)/33,000 = 818 Hp.
B.Hp. = 818/0.71 = 1,150 Hp.

Table III—Discharge Temperature Calculations

EXAMPLE NO. 1

What is the theoretical temperature rise for the compressor described in Example No. 1, Part II? If the adiabatic efficiency is 70 percent what will be the final discharge temperature?

Solution: $H_a = 28{,}080$ ft.
Theoretical temperature rise ΔT = 28,080/188.48 = 152 deg. F.
Actual temperature rise = 152/0.70 = 217 deg. F.
Discharge temperature = 80 + 217 = 297 deg. F.

EXAMPLE NO. 2

What is the theoretical temperature rise for the compressor described in Example No. 3, Part II? If the adiabatic efficiency is 63.5 percent what will be the final discharge temperature?

Solution: Theoretical temperature rise = $H_a/[R(k/k\text{-}1)]$
$H_a = 3{,}672$ ft.
R for steam = 85.58.
k for steam = 1.2973.
Theoretical temperature rise ΔT = 3,672/[85.58 (1.2973/0.2973)/ = 9.8 deg. F.
Actual temperature rise = 9.8/0.635 = 15.4 deg. F.
Discharge temperature = 560 + 15.4 = 575.4 deg. F.

Short-Cut Estimation of

HARLAN HOW

Manager, Jeff Products Division, Jeffersonville Boat & Machine Co., Jeffersonville, Ind.

WHEN PRICE INFORMATION ON WELDED VESSELS CANNOT BE SECURED THE CHARTS GIVEN HERE WILL ASSIST IN MAKING ROUGH ESTIMATES

PROCESS EQUIPMENT COSTS

Many times when it is necessary to have a rough estimate of the cost of non-standard unfired pressure vessels, the estimator's only recourse is the time-consuming one of securing a more or less firm price from a manufacturer. Mr. How's long experience in the production of process equipment has enabled him to work up a group of charts based on average experience which permit a quick "safe-side" estimate to be made covering the cost of gas cutting, plate rolling, edge preparation, welding labor, welding rod and flux. The charts cover butt and fillet welds of U-69, U-70 and API-ASME quality in carbon steel, chrome nickel steel, stainless and nickel clad steels and copper-silicon alloys; several kinds of nozzles; and the machining of plate flanges and heads. Some data are applicable to weldments other than vessels.

WHEN time is more important than great accuracy the charts given here will yield safe (if somewhat rough) estimates of the cost of fabricating unfired pressure vessels in carbon steel, chrome nickel steel, stainless and nickel clad steel and the copper-silicon alloys such as Everdur and Herculoy.

In no way do the data presented in Figs. 1 to 22 reflect the costs of any particular manufacturer. Instead they are a composite of data accumulated by the writer over the years, modified by a factor which will provide a thoroughly safe but not necessarily competitive result. All graphs have been arranged to give as much information as possible without the need for referring to several charts in order to obtain a single answer.

The reader will note that all labor costs are given in terms of man-hours, so that local rates may be applied, while welding rod costs are expressed in pounds of rod per lineal foot of weld (or per nozzle). The only quantities expressed in dollars are the machine rate burden in Fig. 1 and the cost of flux in Figs. 7 and 10. Care should be taken to select the proper rate for mechanics' wages since the rates vary considerably from place to place and frequently vary even within the limits of one narrow locality. If exact figures are not available, a rate of $1.37 to $1.50 per hour should be reasonably safe.

From the drawings the estimator will be able to approximate the cost of materials required for the vessel, while the charts given here permit him to estimate cutting, machining, fitting, assembly and welding time, as well as the weight and cost of welding materials. Having determined these direct costs, it is then necessary to add a factor to take care of shop burdens or machine rate burdens. These factors are both widely used, the shop or over-all burden being the simpler. This is generally figured as being from 90 to 120 percent (or more) of the total direct labor dollar charge. For present purposes this method is preferable to the more complicated methods used by some establishments in which costs are calculated for the various services and machines.

Manufacturing cost, then, is the sum of the material cost, direct labor cost and the shop burden or overhead. The sales price is determined by adding a burden to cover sales, administrative and engineering expense, which generally ranges from 7½ to 20 percent of the manufacturing cost. The final factor, the profit, is then added to the sales cost (manufacturing cost plus sales, administrative and engineering burden). What the profit should be is a matter of individual judgment and may be as low as 5 or as high as 20 percent of the sales cost, depending on the supplier and his appraisal of the market and his own shop conditions with respect to manufacturing load.

Largely self-explanatory, the charts are divided into five groups. Figs. 1 to 3 cover preparatory operations; Figs. 4 to 7 butt welds; Figs. 8 to 10 fillet welds; Figs. 11 to 17 nozzles; and Figs. 18 to 22 machining time on plate flanges and vessel heads. In Fig. 1, which deals with automatic flame cutting with the oxy-acetylene torch, the curve for cutting time is supplemented with a second curve for machine rate burden, in dollars per hour of cutting time (for straight cuts), to take care of both the cost of machine time and the cost of gas. Fig. 2, on time required for the rolling of plates, deals with a very illusive shop cost concerning which somewhat more explanation is desirable.

This chart gives quite a liberal result for plate rolling, since it is based on rolling only a few sheets, which can consume more time than is generally realized. On the ordinary type of pyramid rolls the first and last edge will require forming to shape, generally manually, since the ends cannot be sufficiently rolled to form a reasonably cylindrical shell. The width of these flats may be anything up to 18 in. depending on the diameter of the top roll. With a machine of this type, this fault cannot be corrected. Pinch type rolls require much less hand or break forming and their production will therefore be about four times that of the pyramid type. Re-

Welded Process Vessels

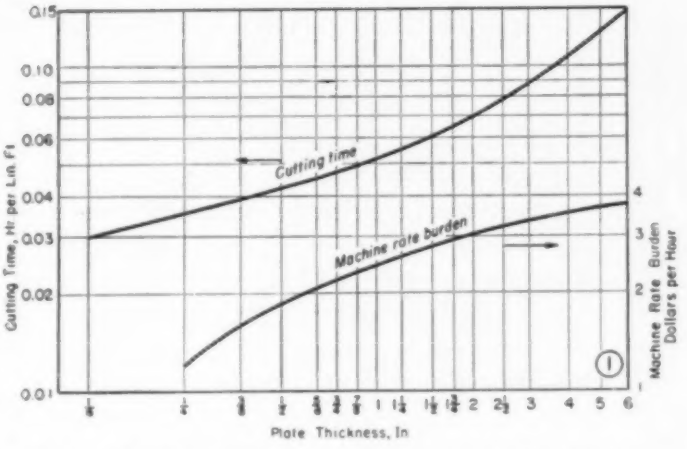

Fig. 1—Cutting time and machine rate burden for flame cutting with automatic machines

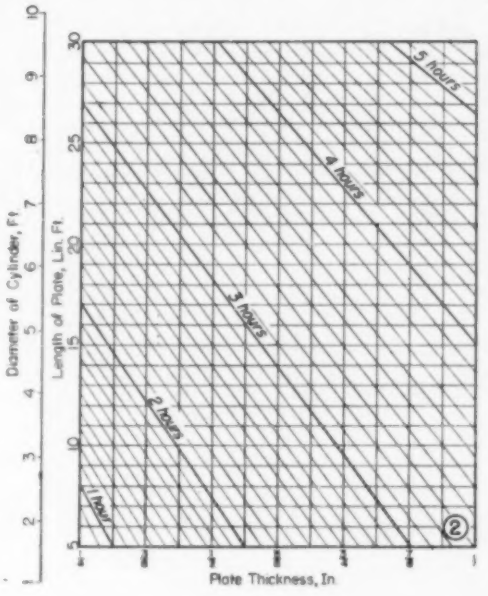

Fig. 2—Time for rolling plates of 60 to 72 in. width in various lengths and thicknesses

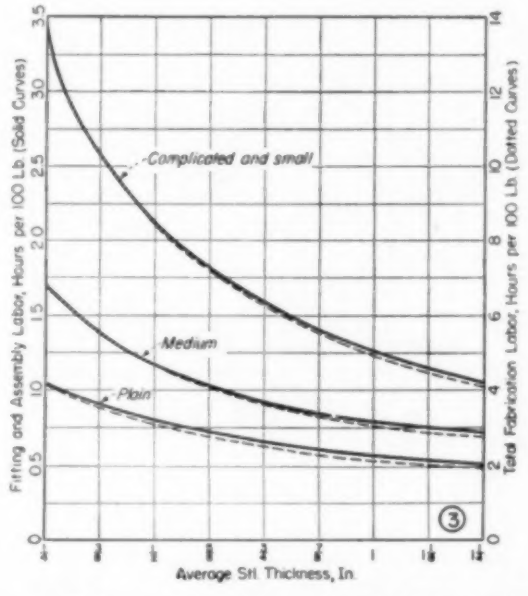
Fitting and Assembly Labor, Hours per 100 Lb (Solid Curves)
Total Fabrication Labor, Hours per 100 Lb (Dotted Curves)
Complicated and small
Medium
Plain
Average Str. Thickness, In
3

Fig. 3—Fitting and assembly, and total fabrication time (for rough check), for steel tanks and weldments

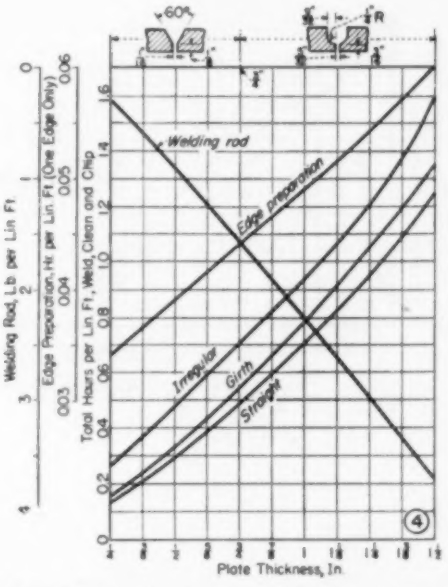

Fig. 4—Welding and edge preparation time and welding rod weight for U-69 butt welds in A-70 carbon steel

gardless of the size, all rolls feed plates through at about 20 ft. per min., but the actual rolling time is not as important as the time required for preparing the plate ends. It is not unusual, in fact, to spend as much time in preforming the plate ends, as is needed in the rolling of several plates.

Fig. 3 has a dual function. It is intended primarily to give the estimator an idea of the time required in fitting and assembling steel tanks and other weldments. However, the dotted curves can also be used as a rough check on the over-all fabrication labor involved in producing such equipment. Much less accurate than the detailed charts that follow it, it can be used to disclose gross errors in the detailed estimate.

Fig. 4 gives a curve for the cost of edge preparation which can be used also in estimating edge preparation costs for Figs. 5 to 7. In Figs. 4 to 10 separate curves are given for irregular, girth and straight seams, since the welding time varies considerably with the difficulty of the weld. Aside from these points it is believed that the various charts will be entirely selfevident in use and need no explanation.

It is to be noted that the data given here cover the costs involved in the production of pressure vessels conforming with paragraphs U-69 and U-70 of the ASME code and with the API-ASME code for unfired pressure vessels. The extra expenses incurred in radiographing, stress relieving, code inspection, and the making of test specimens during construction that are necessary in conforming to paragraph U-68, are not included, and must be studied separately for the estimation of such vessels.

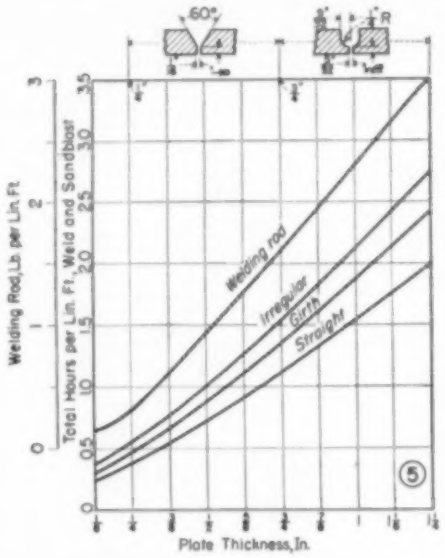

Fig. 5—Welding time and weight of welding rod for butt welds in chrome nickel steel

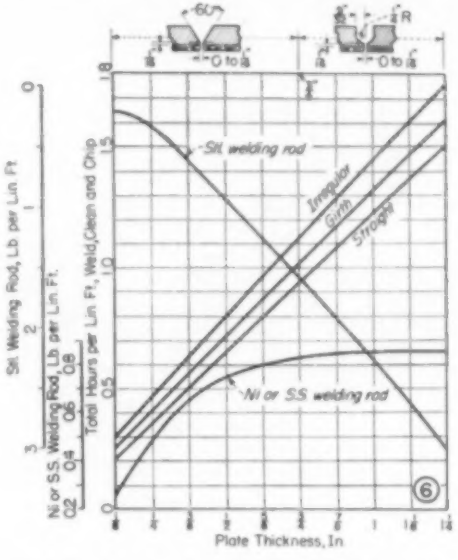

Fig. 6—Welding time and weight of welding rod for butt welds in nickel and stainless clad steel

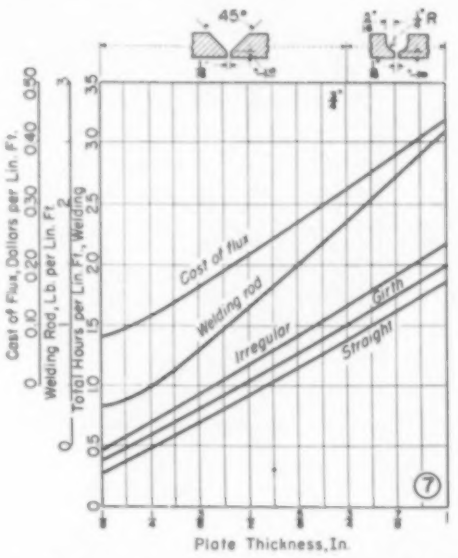

Fig. 7—Welding time, weight of welding rod and cost of flux for butt welds in Everdur and Herculoy

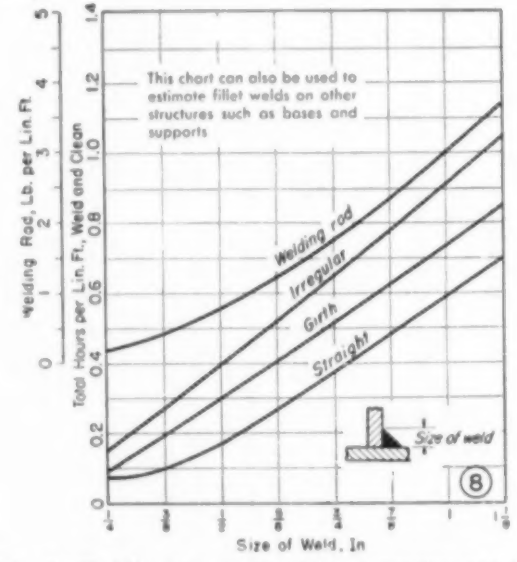
This chart can also be used to estimate fillet welds on other structures such as bases and supports
Welding Rod, Lb. per Lin Ft
Total Hours per Lin Ft, Weld and Clean
Welding rod
Irregular
Girth
Straight
Size of weld
⑧
Size of Weld, In

Fig. 8—Welding time and weight of welding rod for U-69 fillet welds in A-70 carbon steel

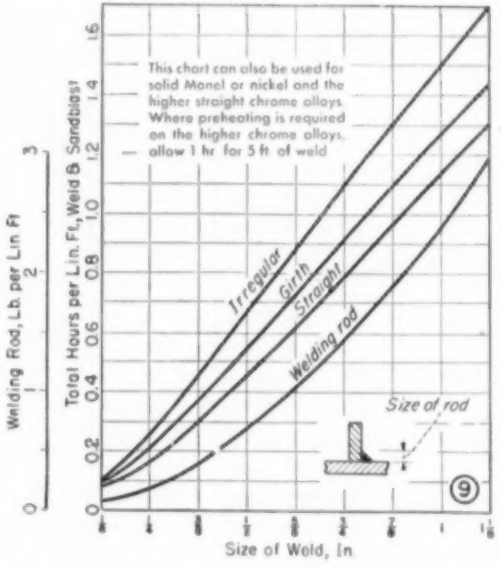
This chart can also be used for solid Monel or nickel and the higher straight chrome alloys. Where preheating is required on the higher chrome alloys, allow 1 hr for 5 ft of weld
Welding Rod, Lb per Lin Ft
Total Hours per Lin Ft, Weld & Sandblast
Irregular
Girth
Straight
Welding rod
Size of rod
⑨
Size of Weld, In

Fig. 9—Welding time and weight of welding rod for fillet welds in chrome nickel steel

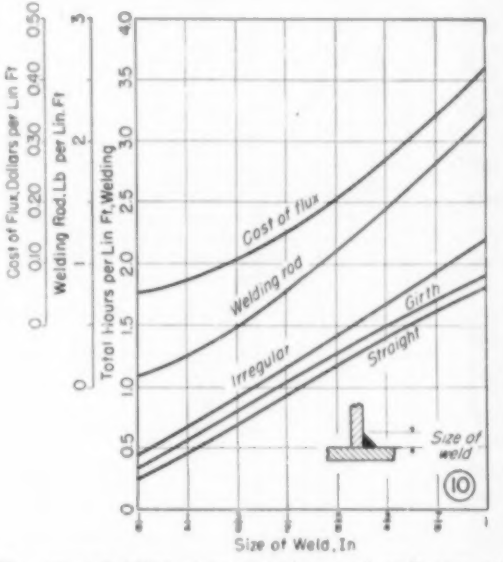

Fig. 10—Welding time, welding rod and cost of flux for fillet welds in Everdur and Herculoy

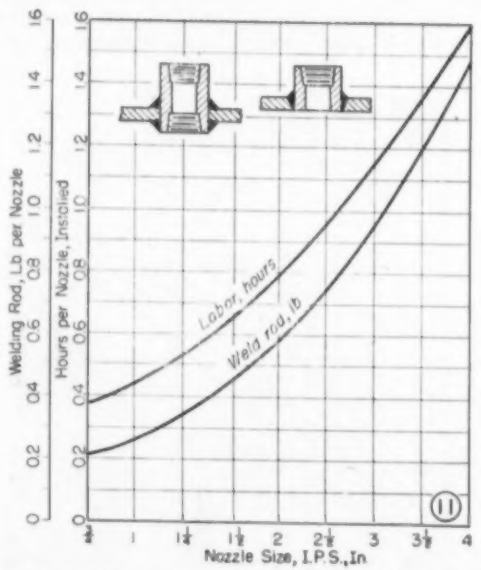

Fig. 11—Welding time and welding rod for installing XH steel couplings in unfired pressure vessels

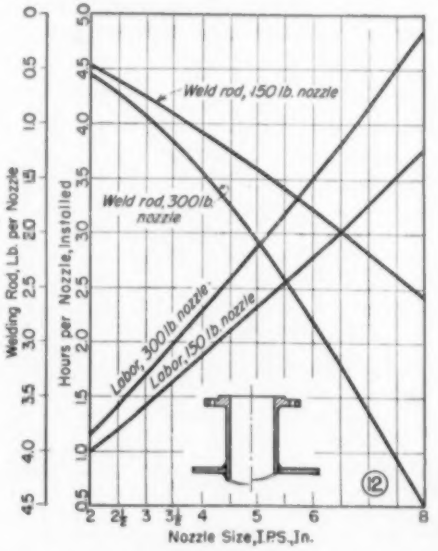
Welding Rod, Lb per Nozzle
Hours per Nozzle, Installed
Weld rod, 150 lb. nozzle
Weld rod, 300 lb. nozzle
Labor, 300 lb. nozzle
Labor, 150 lb. nozzle
Nozzle Size, I.P.S., In.
12

Fig. 12—Welding time and welding rod for installing long welding neck forged steel nozzles (ASTM AIBT)

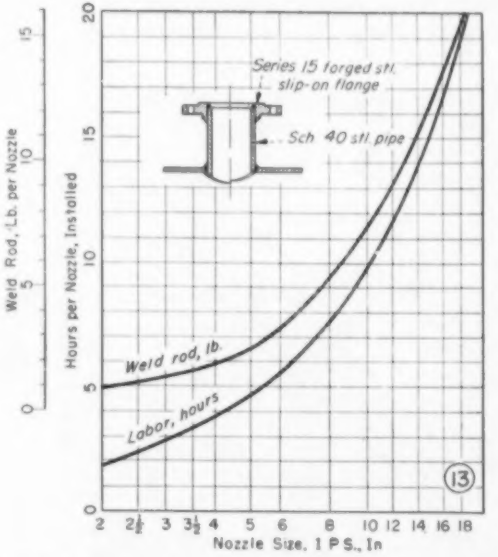

Fig. 13—Welding time and welding rod for fabricating 150-psi. nozzles in unfired pressure vessels

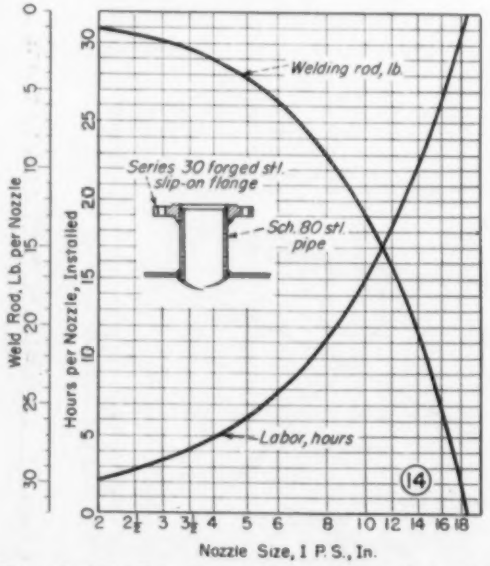

Fig. 14—Welding time and welding rod for fabricating 300-psi. nozzles in unfired pressure vessels

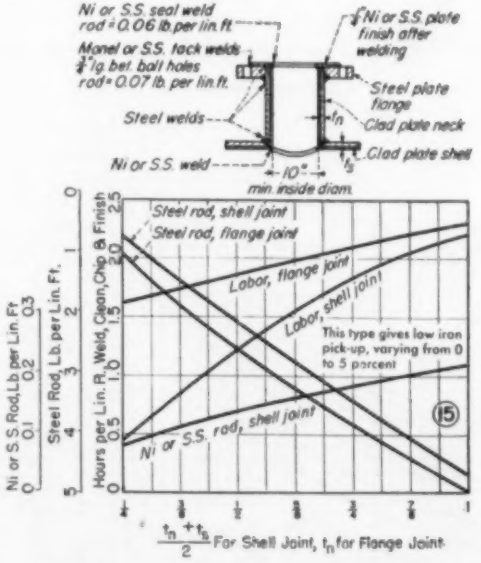
Ni or S.S. seal weld rod = 0.06 lb. per lin. ft.
Monel or S.S. tack welds ¾" lg. bet. bolt holes rod = 0.07 lb. per lin. ft.
Steel welds
Ni or S.S. weld
Ni or S.S. plate finish after welding
Steel plate flange
Clad plate neck
Clad plate shell
10" min. inside diam.
Steel rod, shell joint
Steel rod, flange joint
Labor, flange joint
Labor, shell joint
This type gives low iron pick-up, varying from 0 to 5 percent
Ni or S.S. rod, shell joint
For Shell Joint, tn for Flange Joint
15

Fig. 15—Welding time and rod for nickel and stainless clad nozzles in nickel and stainless clad vessels

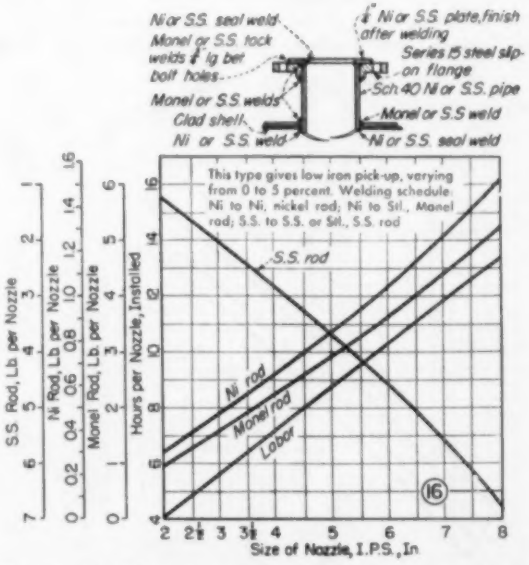
Ni or S.S. seal weld
Monel or S.S. tack welds ¾" lg. bet. bolt holes
Monel or S.S. welds
Clad shell
Ni or S.S. weld
Ni or S.S. plate, finish after welding
Series 15 steel slip-on flange
Sch. 40 Ni or S.S. pipe
Monel or S.S. weld
Ni or S.S. seal weld
This type gives low iron pick-up, varying from 0 to 5 percent. Welding schedule: Ni to Ni, nickel rod; Ni to Stl., Monel rod; S.S. to S.S. or Stl., S.S. rod
S.S. rod
Ni rod
Monel rod
Labor
Size of Nozzle, I.P.S., In
16

Fig. 16—Welding time and rod for nickel and stainless nozzles for nickel and stainless clad vessels

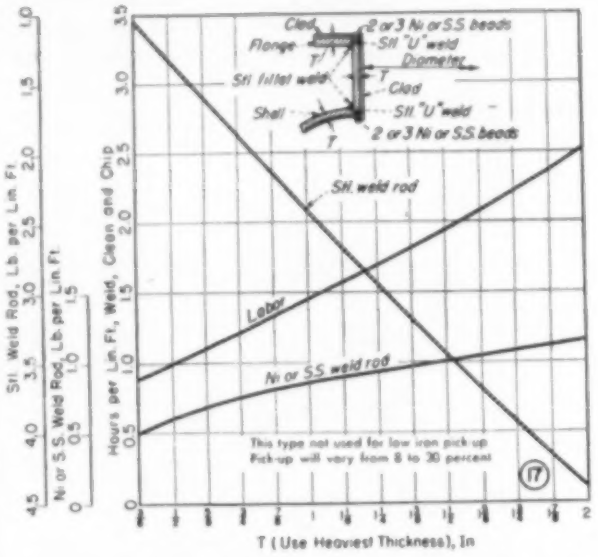
Stl. Weld Rod, Lb. per Lin. Ft.
Ni or S.S. Weld Rod, Lb. per Lin. Ft.
Hours per Lin. Ft. Weld, Clean and Chip
Clad
Flange
Stl fillet weld
Shell
2 or 3 Ni or S.S. beads
Stl "U" weld
Diameter
Stl. weld rod
Labor
Ni or S.S. weld rod
This type not used for low iron pick up
Pick-up will vary from 8 to 30 percent
17
T (Use Heaviest Thickness), In

Fig. 17—Welding time and rod for nickel and stainless clad nozzles in nickel and stainless clad vessels

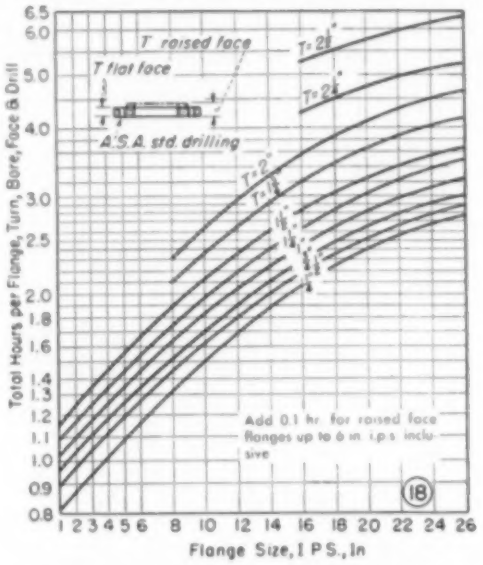
T raised face
T flat face
A.S.A. std. drilling
Total Hours per Flange, Turn, Bore, Face & Drill
Add 0.1 hr. for raised face flanges up to 6 in. i.p.s. inclusive
18
Flange Size, I.P.S., In

Fig. 18—Machining time for carbon steel plate flanges, 1 to 26 in. i.p.s., ¼ to 2½ in. thick

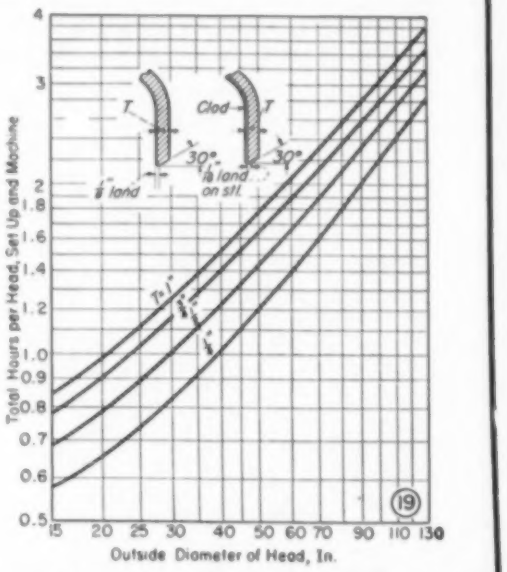

Fig. 19—Machining time, flanged and dished heads, beveled face, carbon and Ni or stainless clad steel

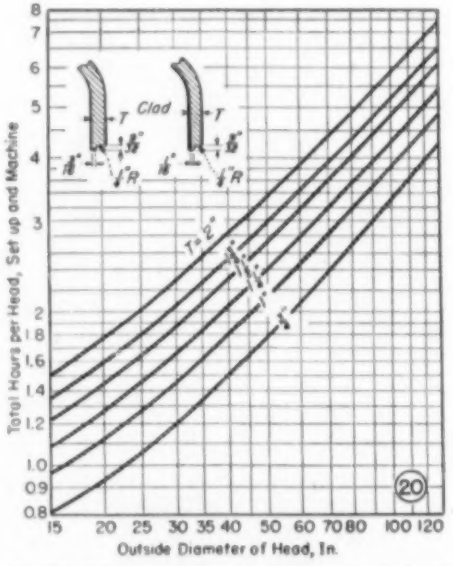

Fig. 20—Machining time, flanged and dished heads, grooved face, carbon and Ni or stainless clad steel

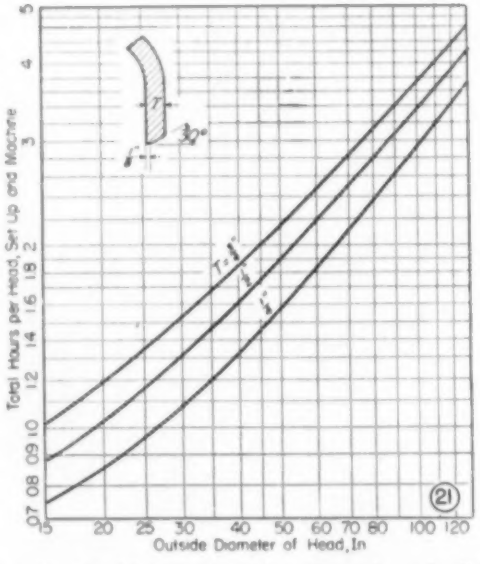

Fig. 21—Machining time for flanged and dished heads, beveled face, chrome nickel steel

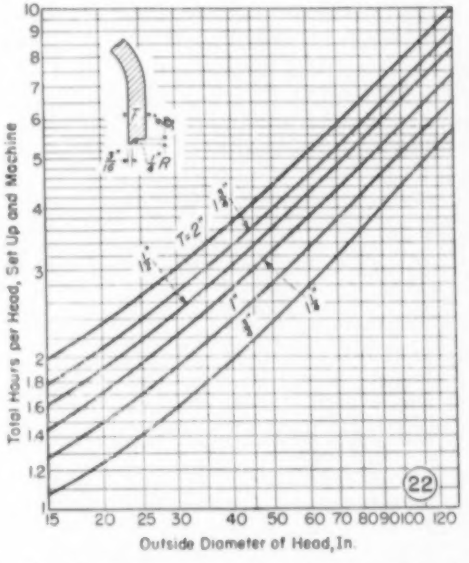

Fig. 22—Machining time for flanged and dished heads, grooved face, chrome nickel steel

Simplified Approach to Mixing Problems

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THE AUTHOR'S METHODS PERMIT READY CALCULATION OF REQUIRED POWER AND MIXING TIME IN MOST LIQUID MIXING APPLICATIONS

Although it has received a good deal of study in recent years, mixing is still more an art than a science, and still suffers from the lack of rational methods of design. It is now generally conceded that power input is a suitable criterion for determining the mixing accomplished, and the author offers a simplified method for predicting what the power should be in a given case. Knowing the power it is possible to calculate the time required to achieve the desired circulation rate, and from that, the mixing time in certain of the less complicated situations.

Among the many unit operations employed in industry, that of mixing is one of the most widely used. However, its broad scope of useful application is complicated by a multitude of variable factors that have presented great difficulties in the development of rational design procedures. While much constructive work has been done in connection with specific problems, and in applying individual types of mixing devices, still, the available data have not been correlated, and no generally acceptable theory has been advanced on which design procedures for practical application can be based. As a result, the users of such equipment must rely on their own practical experience or on that of others, without the possibility of exercising rational judgment in their choice of equipment.

In working out useful and practical methods for design procedures, it is always desirable to reduce the problem to its fundamentals by omitting the less important variable factors. This has been done in the present article, and although the subject of mixing covers gases and vapors, liquids, solids and multi-phase systems, the article is limited to liquids, and fluid mixtures of liquids and solids, in order further to simplify the problem.

There are countless mechanical devices in existence for liquid mixing, most of which are variations or combinations of three basic types of agitator. These types include the paddle, the turbine and the propeller. Their purpose is to impart motion to surrounding liquids, but the motion itself usually accomplishes little mixing. Most of the mixing comes from the agitation that is produced, either by the mixing element proper, or by components of the mixing vessel. There is no entirely clear distinction between the terms mixing and agitation. Generally it is considered that mixing is the desired result, while agitation is the means for bringing it about. In any event, both terms connote a thorough "shuffling" of the particles of the mixture, which obviously cannot be brought about by orderly and undisturbed flow.

Motion of Liquid

Nevertheless, the first requisite in mixing is to set the liquid mass in motion, thereby producing a certain pattern of circulation. It seems logical, therefore, to begin with a study of the problem of imparting motion to liquid bodies confined within surrounding walls. A simple example of such a confined space would be represented by a vertical, cylindrical tank having a flat bottom.

If the entire body of liquid contained in such a tank were to be set suddenly in motion, the movement of the liquid would be curvilinear, and the velocity of motion would vary from zero at the center, to a maximum at a short distance from the tank periphery. With the liquid once in motion the kinetic energy of the mass would then gradually diminish as a result of surface friction, unless energy were supplied continuously.

Under the assumed conditions, no mixing of consequence would take place throughout the main part of the liquid body, since there would be little or no relative motion between the various particles of the liquid (except near the tank wall). To accomplish mixing it is necessary to create shear planes between various liquid layers in the vessel. This may be brought about by several means, including:

1. Application of an agitating device that will produce multi-directional flow.
2. Use of a vessel of irregular shape.
3. Use of obstructions to normal flow, such as baffles, coils, etc. It should be the main objective to create the most complex flow pattern possible, which will result in the greatest possible number of shear planes between the liquid layers. However, the

more complex the flow pattern, the greater will be the power required to create and maintain it at a certain velocity; but conversely, the more complex the flow pattern, the shorter will be the time required to accomplish the desired mixing.

The power needed to produce and maintain continuous agitation of a confined liquid body depends mainly on three sorts of factors: (1) The amount of initial acceleration given to the liquid mass; (2) the amount of energy loss caused by surface friction; and (3) the physical characteristics of the material. This simple analysis of basic conditions points the way to a rational determination of power requirements.

A logical approach to the design of mixing equipment should begin with the determination of the required power input, irrespective of the type of agitating device that may ultimately be employed. The designer may then choose the type of mechanical agitator which his knowledge and experience indicate as most suitable for the particular application. Having selected the type, he may then determine its physical dimensions and speed of operation, so that it will consume the requisite amount of power.

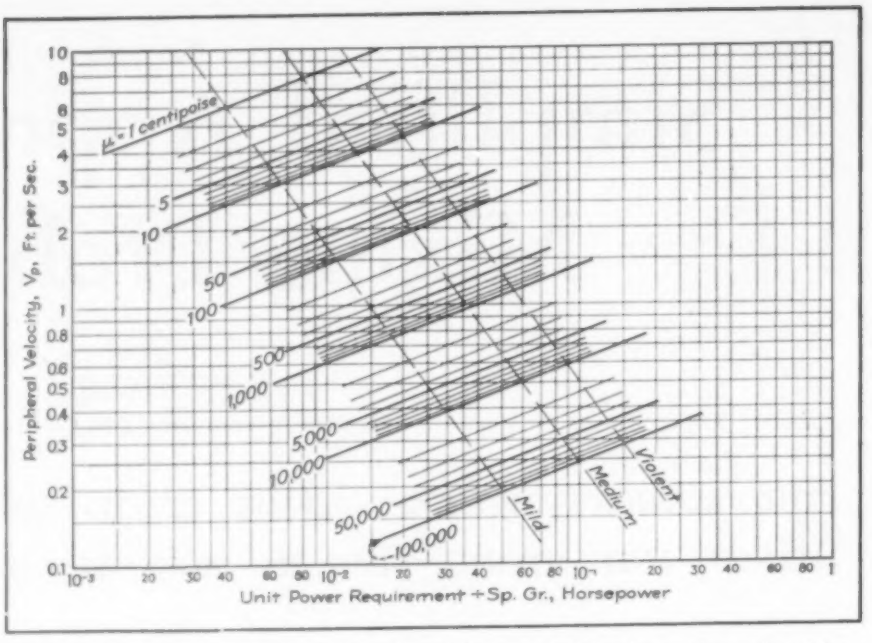


Fig. 1—Unit power requirements and peripheral velocities for various viscosities and intensities of agitation ranging from mild to violent

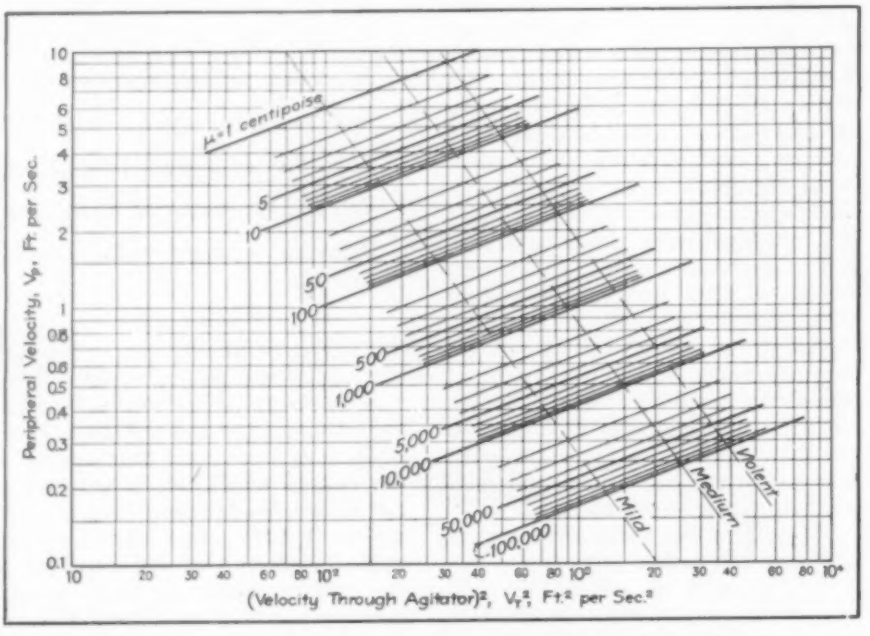


Fig. 2—Initial and peripheral velocities of the liquid for various viscosities and intensities of agitation ranging from mild to violent

Vessel Specifications

A word of caution is necessary. There is a tendency to choose vessel sizes and shapes without a careful consideration of all the factors involved—including the necessity for agitation. This frequently is the cause of low operating efficiency, and sometimes results in unsatisfactory installations. It is often taken for granted that the required agitation can be accomplished somehow, by some as yet undetermined type of agitating device. Such hit-or-miss methods sometimes work out, but this may not be the case where agitation happens to be the controlling factor.

If a liquid in a vertical, cylindrical tank is being agitated in a simple horizontal flow pattern, its velocity of circulation will continue to increase until the power loss through friction against the wetted tank surface equals the power input. If then the power loss per unit of wetted surface is Hp_s and the total wetted surface is A sq. ft., then the total power input Hp required to create and maintain this velocity of circulation will be:

$$Hp = Hp_s \times A \qquad (1)$$

If the liquid is water and the actual velocity near the tank periphery is 6 ft. per sec., actual measurements show that the power loss through friction Hp_{sw} is 0.004 hp. per sq. ft. of wetted tank surface, and the total power loss Hp_w is then $0.004 \times A$. The area A is actually an effective area, varying somewhat from the total wetted area depending on the shape of the tank. For a flat-bottom vertical cylinder, A is equal to the wetted area of the walls plus 55 percent of the area of the circular bottom.

In order to create this velocity of circulation within a reasonable lapse of time, the agitator must impart an initial velocity V_i to the liquid. The time required to bring the tank contents up to full velocity can then be determined as:

$$T = G \times V_i^2 \times \text{sp. gr.} \times 0.00000391/Hp \qquad (2)$$

where T is time in minutes, G is the tank content in gallons, sp.gr. is the specific gravity of the mixture, V_i is the velocity through the agitating device, ft. per sec., and Hp is the power being expended by the agitator. The equation is derived from the well known expression: Hp = (g.p.m.) × (velocity head)/1,718.64, where g.p.m. is gal. per min. flow and the

velocity head is measured in pounds per square inch.

It has been the practice of agitating equipment manufacturers and users to classify various degrees of agitation in simple terms such as mild, medium, violent, or gentle, medium, rapid, etc. For water, and in accordance with this general practice, a peripheral velocity of 6 ft. per sec. corresponds to mild agitation, while 7.7 ft. per sec. corresponds to medium agitation, and 9 ft. per sec. corresponds to violent agitation. These velocities apply also to other liquids having physical characteristics identical to water, regardless of the tank diameter. For other liquids, the velocities will differ, as will be shown later.

In order to create a peripheral liquid velocity of V_p, the impeller must impart a certain initial velocity V_i to a quantity of the liquid. This velocity must naturally be greater than V_p. Similar results will always be accomplished with the same power input. Therefore, as the velocity V_i becomes greater (or smaller), the quantity of liquid passing through the impeller must be reduced (or increased) if constant results are to be achieved. The time required to bring a given quantity of liquid up to the desired velocity of circulation V_p is proportional to the power input and, in order to arrive at a common basis, it is here assumed that the quantity of liquid passing through the impeller in time T is equal to the total quantity G of liquid in the tank.

Initial Velocity Values

On the basis of this last assumption the resultant values of V_{iw} for water are 10 ft. per sec. for mild agitation; 14.13 ft. per sec. for medium agitation; and 17.32 ft. per sec. for violent agitation. Different values of V_i will of course be required for liquids of different physical properties.

Power requirements for the agitation of a liquid mixture are affected by the physical characteristics of the mixture. The power varies directly with the specific gravity. Viscosity affects (1) the velocity V_p of the liquid near the tank wall; (2) the velocity V_i imparted to the liquid by the impeller; and (3) the power loss per square foot of wetted tank surface Hp_u. With μ the viscosity in centipoises, the following equations show how these factors vary as the viscosity and specific gravity vary from that of water. The subscript w denotes water.

$$V_p = V_{pw}/\mu^{0.2} \quad (3)$$

$$V_i = V_{iw} \times \mu^{0.11} \quad (4)$$

$$Hp_u = Hp_{uw} \times \mu^{0.22} \times \text{sp. gr.} \quad (5)$$

As before, V_p is peripheral velocity and V_i is velocity imparted by the impeller, both in ft. per sec., while Hp_u is unit horsepower, that is, power consumption per square foot of effective wetted surface, and sp. gr. is specific gravity.

These equations have been determined empirically and are sufficiently accurate for practical design purposes. Figs. 1 and 2 give the values of V_i, V_p and Hp_u/sp. gr. covering the range of viscosity from 1 to 100,000 centipoises. Use of the charts will be shown later.

Apparent Viscosity

Many fluid materials do not possess true viscosity and will not flow until a definite force is exerted on them. This characteristic is called plasticity. Some materials or mixtures appear to have combined viscosity and plasticity characteristics. In the case of materials that are not truly viscous, the flow characteristics at certain shear velocities are referred to as consistency or apparent viscosity. When such materials are being agitated or mixed, it is necessary to know their apparent viscosities under the assumed operating conditions before a reasonably accurate determination of power requirements can be made.

Another important point should also be noted. Since the power input is controlled by friction loss, it is proportional to the total wetted surface of the tank, and not to the quantity of liquid contained therein. As an example, 50 gal. of a light liquid might be agitated in a barrel with the use of a ½-hp. portable agitator, while a 4,200,000-gal. gasoline blending tank is usually provided with four 25-hp. side-entering agitators, totaling 100 hp. Mixing time for the 50-gal. barrel might be less than 2 min. For the 4,200,000-gal. tank it would be about 2 hr. If the large tank were powered in proportion to ½ hp. for every 50 gal. of its contents, it would require 10,500 hp. and the mixing job should then be accomplished theoretically in less than 2 min.

We now have sufficient information for the calculation of both power requirements and the time to reach the desired peripheral velocity in the case of the simpler mixing jobs. As an example, if a tank 6 ft. in diameter by 7 ft. high is filled within 4½ in. of its top with 1,400 gal. of a liquid having a true viscosity of 20 centipoises, and a specific gravity of 1.2, what will be the power required for medium agitation, and the time to reach the desired circulating speed?

The effective total wetted surface of the tank will be $(6 \times \pi \times 6.42) + (9 \times \pi \times 0.55) = 18.85 \times 6.42 + 28.27 \times 0.55 = 140.34$ sq. ft. From Fig. 1 the unit power requirement would be $Hp_{uw} = 0.008$ hp. if the liquid were water, but for a liquid of 20 centipoises and 1.2 sp gr. it is 0.0154 hp. × 1.2 sp. gr. or 0.0185 hp. per sq. ft. of wetted surface. This can also be determined by calculation from Eq. (5) as $0.008 \times 20^{0.22} \times 1.2 = 0.0185$ hp. per sq. ft. The total power requirement is then $140.34 \times 0.0185 = 2.59$ hp.

We can now calculate the peripheral velocity and the velocity through the impeller. Fig. 2 shows that V_p would be 7.7 ft. per sec. if the liquid were water, but will be 3.14 ft. per sec. for a liquid of 20 centipoises. By calculation we get the same result from Eq. (3); here $V_p = 7.7/20^{0.2} = 3.14$ ft. per sec. for a liquid of 20 centipoises. Similarily, from Fig. 2, V_i^2 would be 200 if the liquid were water, but is 386 (ft./sec.)^2 for 20 centipoises. By calculation from Eq. (4) $V_i^2 = (14.13 \times 20^{0.11})^2 = 386$, whence $V_i = 19.64$ ft. per sec.

Finally, to determine the time T required to set the liquid in full motion, we use Eq. (2). Here T will be $(1{,}400 \times 386 \times 1.2 \times 0.00000391)/2.59 = 0.98$ min.

Effect of Coils

If the same tank were provided with horizontal heating or cooling coils, located near the inside surface of the tank wall, and representing 50 sq. ft. of total effective surface, and if the same liquid velocity $V_p = 3.14$ ft. per sec. were to be maintained, then the tank wetted surface would be equal to 50 sq. ft. more than shown above, or 190.34 sq. ft., and the power required would be $190.34 \times 0.0185 = 3.52$ hp. Now T would be $(1{,}400 \times 386 \times 1.2 \times 0.00000391)/3.52 = 0.721$ min.

This procedure is applicable to most types of agitators, irrespective of the actual velocity V_i imparted to the liquid by the agitator. If a tank is provided with vertical baffles, this will change the horizontal circulation of the liquid to a vertical pattern, with addition of eddy currents, and the mixing effect will be speeded up, even though the general velocity of circulation will be reduced. This is not true, however, in the case of paddles operating at a constant velocity. The reduction of the horizontal velocity of the liquid increases the paddle resistance so that approximately 1.5 times as much power is required to operate the

(*Continued on page 136*)

Good Old Depreciation

W. I. McNEILL

Vice President and Controller, General Aniline and Film Corp., New York, N. Y.

CHEMICAL industry is particularly alert to discussions in current publications over what to do accounting-wise about replacement of buildings, machinery and equipment at very materially increased costs. The reason for concern by members of the industry is the very significant part that the rate of depreciation of buildings, machinery and equipment plays in the total cost of many chemicals.

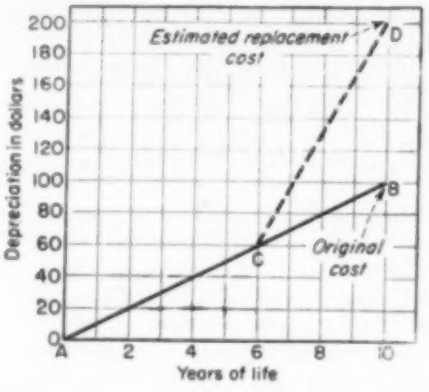
Looking back to 1939 and prior years, it is safe to say that building costs on an average are more than double what they were at that time. While individual items of equipment may cost more than twice what they did in 1939, it is perhaps safe to say that chemical equipment on an average may have increased 50 to 80 percent. The exact increase is not important to the point of this article. It is enough to indicate that a material increase has taken place.

Cost of buildings, machinery and equipment finds its way into product costs through what I have chosen to call "good old depreciation." This article does not discuss the relative merits of such methods of depreciation as straight-line or declining-balance. For simplicity, however, the straight-line method will be used for discussion purposes.

The problem facing the chemical industry may be illustrated by a simple example. Assume that a given piece of machinery cost $100 in 1939. Its useful life was estimated to be ten years. It will, therefore, presumably be worn out by 1949 and need to be replaced. For the purpose of discussion, assume that it will cost $200 to replace this machine.

Under the straight-line method of depreciation, the $10 per year will be charged to manufacturing costs. By 1949 there will have been accumulated a reserve of $100 to be used for replacing the piece of equipment which will then cost $200.

Chemical and other industrial concerns are asking themselves: What accounting technique best expresses the facts of the problem, and what will insure having enough funds to pay $200 for the piece of equipment in question in 1949?



ACB shows accumulated depreciation based on reserving $10 each year of useful life. ACD shows effect of accelerated depreciation at the end of the sixth year to a rate of $35 to provide for a replacement cost of $200.

Some think depreciation should be accelerated and current profits charged so that there will be reserves of as near to $200 as possible by 1949. (See graph.) Others think depreciation should be continued for the case in question at $10 per year and the management, in planning for the future, should estimate future needs for cash for replacement of equipment—along with all other needs—and, if necessary, appropriate a certain amount of surplus or earnings to cover the added cash requirements. This latter method is more realistic.

Consideration of this problem cannot proceed without reviewing one's basic philosophy of accounting. Is not the role of accounting in any business to show the historical facts for any period as they actually exist or happen? It is one thing to show the facts of a business as they happen, and quite another to interpret those facts in the light of any problem to be faced in the future. One of the basic rules of mathematics is always to keep the basis in which the problem is expressed the same throughout the calculation. If one adopts the accounting philosophy of showing the facts as they exist, how can one mix future or anticipated costs with current earnings and keep the mathematical basis the same? Accounting should not be made a tool for expediency or gambling with future possibilities insofar as expressing current earnings are concerned.

Stockholders who invest their money in a business are entitled to see earnings recorded on as factual a basis as possible. If current earnings are high because the assets of a business were purchased at a time when costs were low, then let the facts be recorded as they exist. If an interpretation of the facts indicates that some of the earnings should be set aside, or appropriated from surplus, for increased costs of assets of any kind to be acquired in the future, then conservative judgment will so dictate.

Some of the harmful effects of a policy of adopting a changing or a mixed basis for accounting are:

1. When more than one basis is used for any given problem, you never know what your figures really represent.

2. Unrealistic depreciation gives investors an incorrect picture of the historical earning power of the company.

3. Annual depreciation, which is greater than that necessary to build the full cost reserve within the actual useful life of property, results in fully depreciated property long before its useful life is ended. This is not realistic for cost purposes. Also, if, in 1949, you only have to pay $175, you are over-reserved. (See graph.)

4. Manipulation of the facts of a business for the purpose of expediency may not always produce beneficial results. For instance, if, in the prewar years, a concern took as much depreciation as it could for tax purposes (Let me say, 10 percent.) when the actual rate was nearer 5 percent, it found itself with fully depreciated assets in high-tax years.

More intelligent judgment can be made on the financial needs of any business by having a true accounting record of depreciation than by showing current earnings on a distorted basis. Financing needs of a business can never be changed by bookkeeping methods, hence, if a company presents its historical facts on a constant basis which everyone understands, then possibility for proper interpretation of the facts in terms of future needs is much more certain.

Vannevar Bush, chairman, National Defense Research and Development Board, applauded pharmaceutical industry

George W. Merck accepted the *Chemical Engineering* award for his company's teamwork in science and technology

Dr. H. C. Hinshaw of Mayo Clinic reported that streptomycin holds greatest promise in fighting tuberculosis

As Merck Received Ch.E. Award

Here are the speakers and others who participated in the ceremonies as Merck & Co., Inc., received the eighth biennial Award for Chemical Engineering Achievement for its large scale development of streptomycin. The banquet in New York (see *Chem. Eng.*, Dec. 1947, pp 110-111) brought together almost a thousand representatives of the industry and profession.

Award Committee chairman Alfred H. White presented George W. Merck with bronze plaque symbolizing Award

Representing Merck engineering, production, management and research, and the Award Committee: left to right, B. M. Reynolds, R. P. Lukens, G. W. Merck and R. T. Major of Merck; A. H. White and S. D. Kirkpatrick of the Award Committee

EDITORIAL VIEWPOINTS

Sidney D. Kirkpatrick and Staff

YOUR CHEMENTATOR

MANY of our readers, we suspect, may never have heard of "The Chementator." Yet for ten or so years that brave little publication, issued at infrequent and unpredictable intervals by our Business Department, has carried news about *Chemical Engineering* (and its predecessor, *"Chem & Met"*) to several thousand friends and members of our publishing family. It was and will continue to be our House Organ.

But now, the name takes on a new significance. It becomes, in effect, "Your Chementator." Beginning with this issue, the editorial department we have previously called "Watching Washington" will be replaced by a broader commentary on all the news of the chemical engineering world. It will be written in terser, faster-reading style, for its purpose will be to inform you quickly, and, we hope, accurately, on significant developments and trends not only in the Nation's Capital, but elsewhere in the plants, laboratories, and meeting places of the process industries. Don't expect perfection immediately, but you have our pledge and promise that we will serve you in improving fashion as we draw more fully on the widespread resources of this magazine and its publishing organization. You can help with comment and criticism. Remember, it's *your* "Chementator."

BIG BUT NECESSSARY

SHORTLY every manufacturing industry in the United States will receive certain privileged communications from the United States Census Bureau. For the first time since 1940 all industries are being asked for production data. The general and special schedules this year are big and cumbersome, perhaps confusing at the start, but please remember that there is a big and complicated job to be done. You can help yourself as well as your industry by seeing, first, that the census questionnaires get into the right hands, second, that they are studied carefully and filled out as completely and accurately as possible, and, finally, that they are returned promptly so that there may be early release of the desired totals for the chemical process industries.

BLUE-BITS LATE BOSS

FOR almost twenty-five years Dr. Stephen Miall brightened the lives and sharpened the intellects of thousands of readers of *Chemistry & Industry* in all the reaches of our widely flung science and industry. "Blue Bits," as this slightly anemic journal is affectionately called by most Englishmen, hasn't been quite the same since our warm friend Jones succeeded to the editorship in 1945. Obviously, it couldn't be for there is no second Miall. Stephen's whimsical, kindly cynicisms, his great erudition and broad reading, his contagious enthusiasm for people and places, his love of life and good living—these are the things we shall never forget. Like his American contemporary, the late Ellwood Hendrick, whom he resembled least in appearance and most in his works, Dr. Miall came from outside the chemical profession to love and to lead it—and eventually to leave it much the better for having passed our way.

A NO-RISK BUSINESS

UNDER normal circumstances farming is a business fraught with many hazards. For at least twenty years Congress has tried to eliminate or offset even the unavoidable risks. Sometimes it seems as though they were trying to fix it so that even the most stupid and lazy could make good profits, bungling along with poor farming methods.

No other division of human activity is more important to all of us than the growing of crops and the development of herds and flocks from which the whole population may be fed and clothed. But no legislative body should undertake to make such activity a completely no-risk business. To do so destroys incentive to improve and places burdens on the consumer of farm products beyond his ability to pay.

Lately we have discovered that even the more conservative executives in the Department of Agriculture are arguing for further reduction of risks for the farmer. We are certain that these arguments originate primarily in a desire to have the present Administration return to power for another four years after next November's election.

The danger is that these zealous spokesmen for agriculture will make the issue appear to be a controversy between farmers and city dwellers. We do not like that thought. We believe that the farmers will not like it either for it is bad politics. There is a mutuality of interest between producers and consumers which should not be forgotten even in this year of a presidential election.

SYNTHETIC FUELS

SEVERAL years ago when the government started its program of synthetic liquid-fuel research and development, it looked as though private industry might not be able to conduct these investigations and build the necessary demonstration plants. Now that situation is changed.

Industry has demonstrated that it is now in a position to do most of the commercial-scale development work needed on new synthetic liquid-fuel processes. We believe that industry will do this promptly and adequately. We suggest, therefore, that the Bureau of Mines intensify its fundamental studies in science and in small pilot-scale engineering. We do not think that it is necessary for the government to provide huge continuing appropriations for commercial-scale plant "demonstrations" hitherto authorized. The same amount of money spread over a

longer period on fundamental work will do more good; and incidentally it will redound much more to the credit of the Bureau of Mines.

FUEL SCARCITY

FEW areas in the United States will escape serious fuel shortages this winter. Never before has fuel demand been so great with postwar increases so far outrunning facilities for supply.

A new form of inter-fuel competition has developed. This is the supply of huge quantities of natural gas piped over long distances to reach urban and industrial areas hitherto without the benefit of that highly advantageous source of energy. By this time next year, new pipelines already authorized will be bringing in additional natural gas daily that is equivalent to 300,000 tons of bituminous coal. It is not surprising, therefore, that the railroads, the coal mine owners and unions have been seriously worried by this interstate movement of gas.

But the rush to gas and oil seems to have become a stampede. The obvious advantages of fluid fuels have obscured the potential hazard in depending too greatly on these energy sources. Interruption in tanker and pipeline movement of petroleum, together with possible difficulty in gas pipeline operations combine as a threat against promiscuous, lightly considered adoption of these new energy supplies.

One big factor which chemical engineers must face immediately is that of standby fuel sources. In some cases gas producers, in other cases propane and butane reserves, will serve. But a balanced energy supply so scheduled as to meet any feasible combination of local circumstances is a vital part of good chemical engineering planning. One plant shutdown may cost much more than a precautionary and proper investment now for an emergency fuel supply. Because it may be too late to do much for this winter should not prevent an immediate start on studies and preparations for correction before the fall of 1948.

COMPETING WITH ITS CUSTOMERS

NONE of us likes to add credence to the popular fallacy that prewar Germany excelled in every branch of the chemical industries. But the other day the executive vice president of a typically American company told us that our manufacturers have much to learn from the relations that once existed between German industries and their universities.

In contrast with the aggressive and often competitive research foundations operated by some of our institutions, the German schools maintained more intimate personal and professional relations with their industries. Leading scientists from the various companies were pleased and honored to serve on the faculties of nearby universities. Professors and graduate students were encouraged to seek industrial connections, to work on fundamental and long-range problems of industry. In all this there was an ethical but confidential relationship that does not exist in this country.

Through its trade association, or equivalent, the German chemical industry maintained three groups or foundations of quite a different type to help in the advance of science and its application. The Justus Liebig Co. was concerned with the furthering of chemical teaching, the Adolf Bayer Co. promoted the development of chemical literature, and through the Emil Fischer Co., the various companies helped to finance fundamental research in the Kaiser Wilhelm Institute of Chemistry.

Here in the United States our laws and customs, and the competitive character of our industries, make it impossible to carry out many of these joint undertakings. But before we go too far in governmental subsidies of research in our educational institutions, it would be well for the leaders of chemical industry to promote a better understanding of common objectives concerning its relations with educational institutions. Basically, there is no reason why a university should compete with the industry for which it is training future employees. Likewise, there is no reason for industry to withhold cooperation from a neighboring institution that has proved itself worthy of confidence and support.

PROFESSIONAL RECOGNITION

WHEN the Inter-Professions Conference on Education for Professional Responsibility meets at Buck Hill Falls, Pa., in April, engineering will take its rightful place alongside of law, medicine, religion and business. Three engineering educators—Presidents Doherty and Rogers of Carnegie Tech and Brooklyn Polytechnic, with Dean Thomas K. Sherwood of M.I.T.—will join leaders from the other professions to discuss war-created problems of professional education that all have in common. From this sharing of the different experiences of the several professions should come further opportunities for mutual assistance in meeting the needs of our times. The Carnegie Corporation and its Foundation for the Advancement of Teaching are to be commended for foresight and leadership in initiating what should prove a continuing program.

Volume 55—Chemical Engineering—Number 1

Chemical Engineering, with which is incorporated *Chemical & Metallurgical Engineering*, is the successor to *Metallurgical & Chemical Engineering*, which in turn was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*, effected in July 1906.

The magazine was originally founded as *Electrochemical Industry*, in September 1902, and was published monthly under the editorial direction of Dr. E. F. Roeber. It continued under that title until January 1905 when it was changed to *Electrochemical & Metallurgical Industry*. In July 1906 the consolidation was made with *Iron & Steel Magazine* which had been founded eight years previously by Dr. Albert Sauveur. In January 1910 the title was changed to *Metallurgical & Chemical Engineering*, and semi-monthly publication was begun Sept. 1, 1915. On July 1, 1918, the title was changed to *Chemical & Metallurgical Engineering* and weekly publication was begun Oct. 1, 1919. Monthly publication was resumed in March 1925.

In August 1946 the words *"& Metallurgical"* were dropped from the main title to bring its name more in keeping with the editorial content.

Dr. E. F. Roeber was editor of the paper from the time it was founded until his death Oct. 17, 1917. After a brief interim he was succeeded by H. C. Parmelee. Ten years later, Nov. 1, 1928, Mr. Parmelee assumed other responsibilities in the McGraw-Hill Publishing Company and Sidney D. Kirkpatrick was appointed editor.

The present editorial staff of the magazine comprises, in addition to Mr. Kirkpatrick: James A. Lee, managing editor; H. M. Batters, market editor; T. R. Olive, associate editor; L. B. Pope, R. W. Porter, E. C. Fetter, R. F. Warren and J. A. O'Connor, assistant editors. Editorial regional representatives are: J. R. Callaham and J. F. Cosgrave, San Francisco; J. V. Hightower, Houston; R. S. McBride, Washington; E. S. Stateler, Chicago; and Earle Mauldin, Atlanta.

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Heat Transfer Symposium

HEAT transfer, a factor of prime importance in nuclear energy development, was the subject of a week-long symposium held December 8-13 at Oak Ridge, Tenn., under the sponsorship of the Nuclear Energy Powered Aircraft Division of Fairchild Engine and Airplane Corp. Twenty-eight speakers from industry and the universities presented papers on aspects of convection, conduction, radiation, boiling, condensation, mathematical and analog methods, and materials of construction.

General T. A. Sims, general manager of NEPA; Gordon Simmons, technical director of NEPA; and W. P. Miller, executive, Atomic Energy Commission, welcomed the group of approximately 400 engineers who attended the meeting. J. Carlton Ward, president of Fairchild, gave a short address on the major importance of heat transfer.

Theory and Data

Papers described theory and presented experimental data for a wide variety of cases. Hunter Rouse, University of Iowa, showed that use of continuous lines of gasoline burners at ground level to study heat requirements as a function of burner location and cross-wind velocity yielded results which are considered applicable to all similar problems of gravitational diffusion from a boundary source. From experimental work at Massachusetts Institute of Technology, J. H. Keenan related the friction and heat transfer factors to the development of the boundary layer for subsonic and supersonic compressible flow. A. H. Shapiro, MIT, presented a one-dimensional analysis for flow without shocks, taking into account the simultaneous effects of area change, wall friction, heat exchange, chemical reaction, change of phase, and changes in molecular weight and also in specific heat.

Methods were presented by H. C. Hottel, MIT, for determining temperature distribution in enclosures containing specified heat sources and sinks, with modifications introduced by superimposed gas convection. In his paper on high densities of heat flux, W. H. McAdams, MIT, showed that peak density of heat flux can be increased by (1) use of subcooled liquid, (2) increase of velocity past the heat transfer surface, and (3) use of the most favorable pressure. Basic heat transfer equations and limitations of these equations were presented by Herman J. Stoever, Iowa State College. In a paper on the effect of vapor velocity on condensation inside tubes, A. P. Colburn, University of Delaware, showed that a new treatment of condensate turbulence resulted in a relatively simple relation for determining the heat transfer coefficient.

Presenting a paper on heat transfer rates to flowing granular solids, R. L. Pigford, University of Delaware, showed that existing heat transfer equations for rod-like flow of fluids correlated experimental data for the case of constant tube-wall temperature, if the thermal conductivity of a stationary bed of granular solid was used to evaluate the Graetz modulus. A heat balance equation was presented by R. H. Wilhelm, Princeton University. F. W. Bubb, Washington University of St. Louis, explained the theory of direct current networks for solving heat flow problems.

M. F. Valerino, National Advisory Committee for Aeronautics, developed equations for compressible flow of a gas stream for three different cases. A paper on heat transfer to boiling liquids at saturation temperature was presented by Charles F. Bonilla, Johns Hopkins University. Special laboratory apparatus for measuring rapidly fluctuating temperatures in solid bodies and gas streams was described by G. A. Hawkins, Purdue University. In a paper by Byron E. Short, University of Texas, data of investigations in fluid mechanics were used to calculate pressure losses in heat exchangers having various baffle types, tube sizes and spacings.

Describing recent work on finned tubes at the University of Michigan, Donald L. Katz presented data for the following cases: (1) air flowing across single tubes and tube banks; (2) liquids and gases flowing in an annulus outside a finned tube; (3) condensation outside a single spiral finned tube, outside of six tubes in a vertical row, and in a commercial refrigerant condenser; (4) boiling of liquids outside finned tubes. In a paper entitled, "Exploding a Heat Transfer Myth," Benjamin Miller, consulting engineer, traced the film theory of thermal resistance up to the present time.

J. W. Freeman, University of Michigan, presented information on types, significant properties, and possible applications of heat-resisting materials now in the research stage.

In a paper on heat transfer to oils in tubular exchangers, O. P. Bergelin, University of Delaware, presented data on the effects of tube arrangement, viscosity, and leakage around the tube bundle. R. L. Scorah, University of Missouri, showed a motion picture on boiling water with a heated wire, along with his presentation of other data on the effects of pressure change and nature of metal surface. Heat transfer investigations in a recirculating atmosphere furnace were described by C. A. Siebert, University of Michigan. Fundamental heat transfer considerations were presented by L. M. K. Boelter, University of California, with reference to two cases in particular: (1) combined forced viscous and free convective flow; (2) entrance effects for flow through tubes.

Calculations

In a paper on prediction of recovery factors, Howard W. Emmons, Harvard University, presented a simple expression for laminar flow of a constant velocity free stream. In cases which are too complicated for formal solution of the differential equation for heat conduction with transient conditions, G. M. Dusenberre, University of Delaware, showed that, making certain assumptions, numerical solutions can be found by means of the finite-difference equation. S. M. Marco, Ohio State University, developed expressions for computing the net interchange of heat between a body and its surroundings when heat is transferred by radiation alone. In a paper presented by L. M. K. Boelter for R. C. Martinelli, General Electric Co., heat transfer to molten metals was examined.

Radiant heating of thick objects possessing low thermal conductivities was the subject of a paper by Harold J. Garber, University of Tennessee. Operating and design data were included in a paper by K. W. Coons, University of Alabama, on the "spiral" and contact types of heat exchangers. Townsend Tinker, Ross Heater and Manufacturing Co., presented fluid flow patterns and a new method for evaluating mass flow rate on the shell side of a segmentally baffled shell and tube heat exchanger.

It is expected that a transcription of the proceedings will be available in the near future. Further information may be obtained from S. Turkel or Don Cowen, NEPA Division, Fairchild Engine and Airplane Corp., Oak Ridge, Tenn.

Reported to *Chemical Engineering* by W. B. Harrison and R. M. Boarts, Clinton Laboratories, Oak Ridge, Tenn.

THE PLANT NOTEBOOK

Theodore R. Olive, ASSOCIATE EDITOR

$50 CASH PRIZE FOR A GOOD IDEA!

Until further notice the editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. The winner each month will be announced in the issue of the next month: e.g., the January winner will be announced in February and his article published in March. Judges will be the editors of *Chemical Engineering.* Non-winning articles submitted for this contest will be published if acceptable, in that case being paid for at applicable space rates.

Any reader of *Chemical Engineering,* other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 300 words, but illustrated if possible. Neither finished drawings nor polished writing are necessary, since only appropriateness, novelty and usefulness of the ideas presented are considered.

Articles may deal with any sort of plant or production "kink" or shortcut that will be of interest to chemical engineers in the process industries. In addition novel means of presenting useful data, as well as new cost-cutting ideas, are acceptable. Address Plant Notebook Editor, *Chemical Engineering,* 330 West 42nd St., New York 18, N. Y.

DECEMBER WINNER

A $50 prize will be issued to

J. F. SCHNACKY

Chemical Engineer, Buflovak Equipment Division of Blaw-Knox Co.
Buffalo, N. Y.

For an article showing how to save both cooling water and condenser area in recovering steam distilled solvents, which has been judged the winner of our December contest.

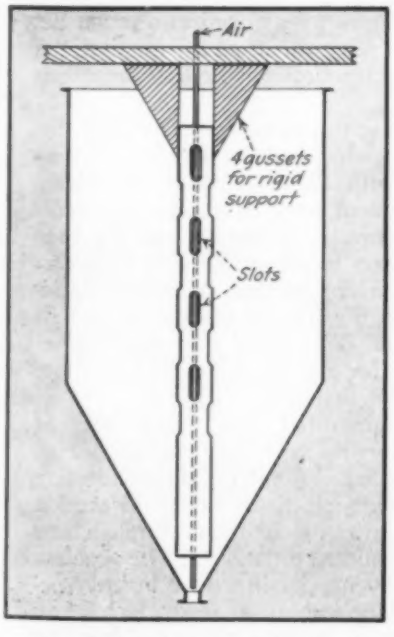
This article will appear in our February issue. Watch for it!

November Contest Prize Winner

AIR LIFT AGITATOR FOR VARYING TANK LEVELS AND COARSE, HEAVY SLURRIES

H. W. HEISER
Research & Development Dept., Aluminum Ore Co.
East St. Louis, Ill.

SEVERAL years ago I devised a modified air lift which was simple but nevertheless very useful and effective in a difficult agitating problem. It was necessary to maintain a suspension of a heavy slurry of rather coarse grains of material in water. More difficult, it was essential that the tank contents be kept well mixed regardless of wide variations in level. This non-uniform level resulted from variations in the volume charged to the tank at different times, as well as differences in level when a portion of the charge was removed.



Slotted air lift for variable level

In order to make the air lift function at any level the tube casing was slotted as the sketch indicates. The number and size of the slots was sufficient to permit the lifted slurry to leave the tube near the level of the slurry, thus effecting good agitation.

PRESSURE CONVERSION CHART FOR MOLDING OPERATIONS

EDWARD H. TEN EYCK, JR.
Pearl River, N. Y.

IN MOLDING operations, such as are encountered in the rubber and plastics fields, it is frequently necessary to convert the ram or fluid pressure of the press into the pressure applied to the molded piece. The usual method is to multiply the gage pressure by the ratio of the mold and ram areas. This converted pressure is more easily determined with an alignment chart and the accuracy of the method is certainly within the accuracy of the pressure gages usually employed.

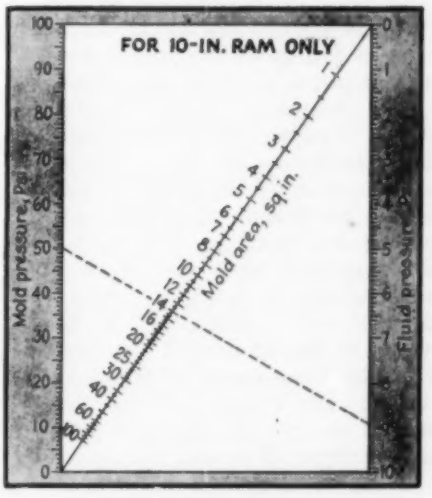


Chart for mold pressure calculations

An example will demonstrate the use and convenience of the chart. What is the fluid pressure required in a press with a 10-in. diameter ram, to give a pressure of 5,000 psi. on a molded piece having an area of 14 sq. in.? By calculation $P \times \pi \times 10^2/4 = 5{,}000 \times 14$ and $P = 5{,}000 \times$

14/78.5 = 892 psi. From the chart P = 892 psi.

A mental calculation for the location of the decimal point must be made as the right scale is one-tenth of the left scale. As with a slide rule, the pressures on the chart can be any multiple of 10.

It must be remembered that the chart shown can only be used with ram diameters of 10 in. For other ram sizes, additional charts must be drawn. This is readily accomplished by referring to any text on alignment charts or to Perry's handbook. If it is desired, the mold pressure can be found from the fluid pressure by using the chart in reverse.

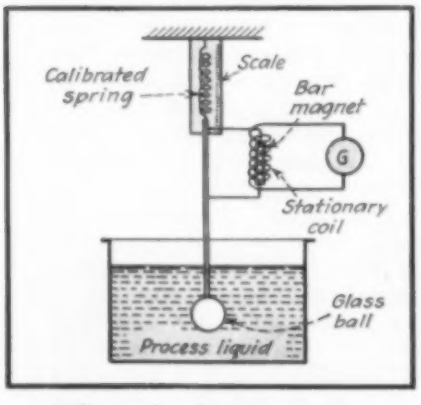
Once it is constructed, this simple "Z" type chart saves a great deal of time in making mold or fluid pressure conversions.

AUTOMATIC DETECTOR FOR DENSITY CHANGES

A. Y. TABANI
University of Wisconsin
Madison, Wis.

IN CERTAIN constant density processes it is desirable to know quickly when changes in density of the process material take place. A simple way to detect such changes is to use a spring balanced "displacer" coupled to some form of indicating or alarm device. One arrangement is indicated in the sketch. A heavy ball—of glass, for example—is immersed in the process liquid, suspended by a neck from a sensitive spring. It is a good idea to guide the neck rather carefully to eliminate at the tendency to wobble. The smaller the diameter of the neck, of course, the greater will be the change in level of the displacer with density changes. If desired the spring can be calibrated against solutions of known density and a scale provided as shown.

To give a simple indication when a change in density is taking place the arrangement of the sketch can be used, employing a bar magnet carried by the neck, riding in a coil in series with a galvanometer or sensitive millivoltmeter. When a change is taking place a voltage will be produced in the coil, the magnitude of which depends on the speed of change. If desired a sensitive relay can be substituted for the galvanometer to ring an alarm. Or a split coil can be used instead of the simple coil indicated, and connected into two arms of an induction balance (bridge) in which case the galvanometer indication will be a measure of density, rather than rate of change.

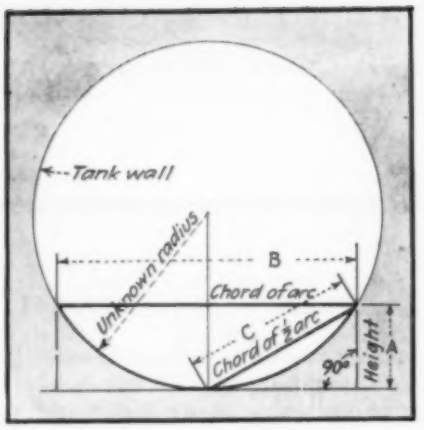


Indicator for density variations

HOW TO FIND RADIUS OF A TANK

PAUL C. ZIEMKE
Oak Ridge, Tenn.

IT IS OFTEN necessary for pipe fitters, electricians and other mechanics to lay out proper bends in pipe or tubing to fit the curvature of existing cylindrical equipment such as tanks, boilers, etc. With a simple geometric trick that is unknown to most people a good deal of time can be saved in finding the unknown radius. As the sketch indicates, select any length of arc of the tank and measure its height and the length of the chord of one-half the arc. Then, if the chord of half the arc is C and the height is A, $R = C^2/2A$. For example, if the chord of the arc is 72 in., the height is 16 in. and the length of the chord of half the arc is 40, $R = 40^2/2 \times 16 = 50$ in.



How to find an unknown radius

MIXING PROBLEMS
(Continued from page 129)

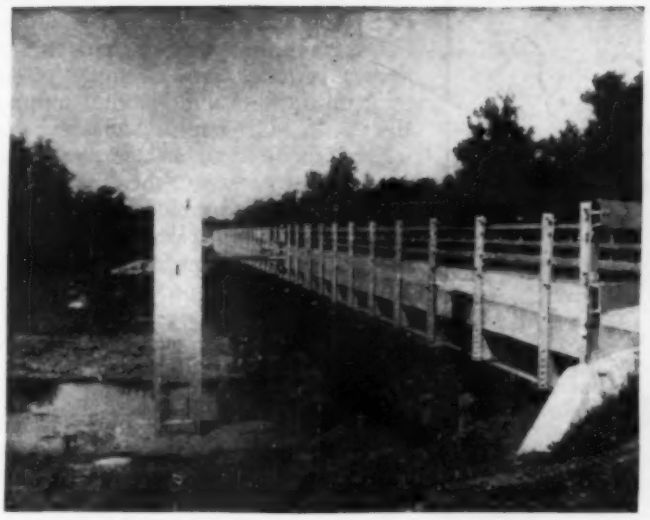
paddles at the same speed. In the case of horizontal, square or rectangular tanks, the speed of circulation is reduced as compared with a vertical cylinder, the pattern of circulation becomes more complicated, and eddy currents are created. All this increases the mixing efficiency, so long as the liquid velocity is not allowed to drop too low in any part of the vessel. It is therefore advisable to consider medium agitation as a minimum requirement in such cases.

Up to this point we have considered only the time to bring the liquid to its final velocity, but not the time to complete mixing. Mixing time is a function of the degree of agitation, the pattern of circulation and, of course, the physical characteristics of the materials involved. The time T required to bring the liquid body up to circulation velocity represents a convenient basis for determination of the mixing time T_m. If the materials to be mixed are readily miscible liquids, the minimum time required to accomplish thorough mixing will vary from $3T$ to $6T$, depending on the general pattern of circulation. In a vertical tank of normal proportions, and with a simple circular pattern of circulation, $T_m = 6T$; in a similar tank provided with the proper vertical baffles to create a complex pattern of circulation, $T_m = 3T$.

In mixing finely divided solids with liquids the same conditions will prevail, except in the case of heavy solids that tend to settle rapidly. Then the circulation velocity must be of sufficient magnitude to keep the solids in suspension. When solids are to be dissolved, the time factor depends, of course, largely on the dissolving rate. In the case of a chemical reaction between components of the mixture, the rate of reaction may be the controlling factor.

Using the methods outlined in this article, any engineer familiar in general with the application of mixing equipment can determine rationally the power requirements and the time necessary to accomplish any particular fluid mixing process. However, deciding on the type of equipment and its physical dimensions and operating velocity for a given mixing job is quite another matter.

As discussed here, most types of agitators do very little mixing *per se*, but accomplish mixing through setting the materials to be mixed in motion and providing agitation through one of the means mentioned. The problem of reducing mixing time in any specific application depends largely on ability to increase the actual amount of mixing accomplished by the agitator.



IN MAY of 1940, stream flow at Bayou Des Cannes near Eunice, La., was 14 cfs. according to the automatic stage recorder installed by USGS in the concrete stilling well

IN AUGUST, stream flow was 7,500 cfs. Decision as to industrial location or expansion often hinges upon water supply. Adequate records and knowledge save financial loss

WATER SUPPLY

REPORT

Water supply in adequate quantity of suitable quality is important to more units of process industry than any other single material or service. Despite its importance, water supply is a commonly neglected factor in many establishments. More and more this neglect is becoming serious. This report is intended to summarize some of the factors influencing quantity and quality of water supply as related to the needs or desires of the process industries. It is in no sense a substitute for investigation or planning. It cannot be. Each establishment has peculiar needs or peculiar problems which require individual analysis or correction; careful study and dependable planning, case by case.

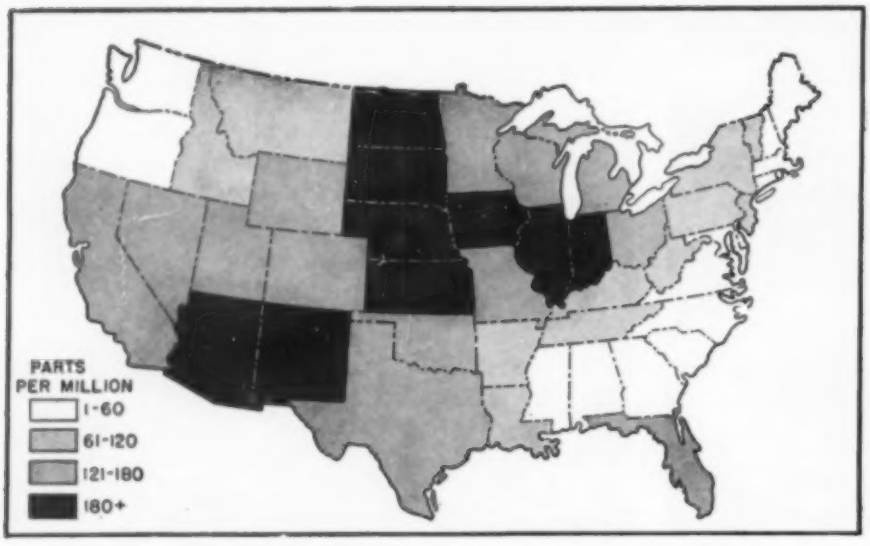
WATER needs of each individual establishment, especially those which are large and complex, are often made up of several quite distinct requirements. Process water, process cooling water, water as a conveyor, boiler water, power plant condensing water, and other needs are too often separately considered. Each must be individually studied, but the composite is not merely the sum of the several items. The plant engineer who so treats his water problem is more often than not wasteful or even grossly extravagant.

The first step toward solving the water problems of present and prospective operation is taken by individual analysis of each water-using or water-consuming step in the entire enterprise. It is generally profitable to make a re-survey of this sort at periodic intervals for each establishment that is a large water user. Certainly it is unsafe not to make such a re-survey at least once in five years. And it is usually important that each such study be almost as thorough as a plant site investigation should be.

Water needs of growing companies require re-study merely to keep pace with the changing scale of plant operations. It is almost equally important that each process change be considered, even before adoption, as to its influence on water demand. Not often, but at times, this factor may be a determining one for or against a change of plant practice. Water costs money. That fact should not be forgotten in an over-all process appraisal.

Sources of Water

Small establishments commonly take for granted that they should depend on the municipal water supply system of their localities. There are, however, many instances in which an alternative source of water can be found which may contribute substan-



WEIGHTED AVERAGE HARDNESS, by states, of the water furnished in 1932 by the public supply systems in more than 600 cities in the United States

tially to the over-all economy of the works. In some cases water from a nearby stream is available. In others, ground water can be tapped economically through wells drilled on the premises. Occasionally neighbors with water supply facilities have a surplus which may supply the requirements cheaper than the municipal distributing system is able to do. This is especially true if a plant is so located that new service mains may be needed to meet plant requirements.

Generally speaking, the larger establishment should think first of providing itself with water supply, rather than taking it from an urban system. Then, of course, both surface water and ground water deserve consideration.

Site Selection

When any company goes out to choose a new plant location, the character and cost of water is one of the substantial factors deserving attention. This factor is now more important than heretofore because many processes today demand huge quantities of water, and a substantial number have special quality requirements that cannot be ignored. Incidentally, the "quality" of water refers not only to chemical composition and to suspended impurities, it also is used to refer to the temperature of the supply.

Not the least important in site appraisals is the prospect for years ahead, as contrasted with the immediate situation found currently at an otherwise attractive new plant location. Where up-stream considerations are neglected, it is often a cause of great difficulty later, since up-stream neighbors can be most disconcerting in their influence on dissolved and suspended components as well as on the temperature of supply. Hundreds of plant engineers can testify to the fact that conditions once satisfactory may quite abruptly become alarmingly bad, due to up-stream changes of this character. This applies, to some extent, to underground as well as to surface water.

Ground Water Supply

Most chemical engineers during college days have been exposed, at least casually, to elementary geology. But most of us have long since forgotten the basic relationships then studied in order to pass the next term test. Brief review here of those principles as they affect ground water seems in order.

Typical Industrial Water Needs

(Gallons per Ton of Product)

Industry	Gal.
Bromine	5,000,000
Synthetic rubber (GR-S)	600,000
Magnesium from sea water	300,000
Viscose rayon	180,000–200,000
Cuprammonium rayon	90,000–160,000
Cotton goods, bleaching	60,000–80,000
Dyeing	8,000–16,000
Sulphate pulp	70,000
Soda pulp bleaching	60,000
Leather, chrome tanning	30,000
Vegetable tanning	6,000
Alcohol from molasses*	
For cooling	42,000
For process	10,000
Cane sugar refining	
For condensing	4,000–9,000
For process	1,500
Cottonseed oil refining and hydrogenation	6,600

These estimates by Dow Chemical Co., Freeport, Tex. * Per M gal.

Underground water comes from surface precipitation. The rain and snowfall may occur a few or many miles away. In one classical study often used to illustrate underground supply, the U. S. Geographical Survey described the case of artesian water of great importance furnished by mountain rainfall at a distance of nearly 100 miles. Incidentally, we are apt to forget that the flow from such mountains to the artesian well occurs very slowly. Often water is not weeks or months, but rather years or even decades, in moving from the point of fall to the point of use.

Two broad classes of underground movement of water are recognized by geologists. In the one case channel movement occurs, so that the underground flow may actually amount to a few miles per day through cavities or cavern spaces. Far more common, and for most industry far more important, is the underground slow seepage of water through permeable strata where the rate of flow depends on permeability of the mass. In the vast majority of cases, ground water reaches the point of pumping or free flow to the surface by that method.

The Water Table

In most areas water flows more or less constantly from points of precipitation into the ground, gradually seeking the lowest level accessible through permeable ground mass. At any particular point the level which is commonly maintained by the water under the ground is referred to as the water table. When studying ground-water supply, the first step is a determination of the normal level of this water table and its normal fluctuation. Determination of the level at any particular time is not difficult. Appraisal of short term fluctuations involves only a bit more uncertainty. Even seasonal variations can be fairly accurately determined without waiting a year if records of nearby wells can be found. But the cyclical swing which occurs over a period of years is not nearly so readily judged.

U. S. Geological Survey studies show the danger of using single observations, either those limited in time or very much limited in area. The level of water in the ground and the quantity that can safely be taken from any well or group of wells are facts reliably determinable only with a series of observations over a substantial area for a reasonable period of time. This fact is convincingly proved when one realizes that there are daily, weekly, and seasonal changes, as well as many fortuitous ones. Even the passage of

a heavy train over nearby land may affect the apparent water level. And in most cases ground-water levels are significantly different on Sundays and holidays and may even be affected by wind and weather either locally or some distance away.

Engineers who intend to undertake by themselves some ground-water appraisals will do well to get and study "Outline of Methods for Estimating Ground-Water Supplies," by O. E. Meinzer, which is one chapter of U. S. Geological Survey Water-Supply Paper 638.

The Weather Cycle

Water supply engineers tell of one interesting case that shows how this "cycle" may be anything but a smooth sine-curve relationship. In one of the semi-arid areas of the Southwest water users had been concerned over a period of twenty or twenty-five years because of the gradual lowering of the water table. Wells had to be dug deeper and pumping costs constantly increased. Suddenly in a single year there was an abnormally high rainfall in the supply area some miles away. Within less than twelve months the water table came back to levels from which it had receded over a period of two decades or more.

Another example often cited is the experience of the upper Mississippi Valley, notably central Minnesota. From the early years of this century until the middle 30's, lake levels and ground water supply declined gradually until many lake shore cottages were literally hundreds of feet from the water, and many wells and streams which "never failed" became dry holes or dry creek bottoms except briefly after a rain. There was much talk that the climate of the whole area was undergoing change.

This long period of recession in water supply suddenly ended. Storms which theretofore dumped most of the Pacific water over eastern Great Lakes States returned to their former habit of heavy rainfall in southern Manitoba, Minnesota, and adjoining areas. Within two or three years lakes came back to their old shore lines. Wells again gave abundant supply. Thus the change of climate was identified as merely a long irregular cycle in the weather habit of the area.

Ground Permeability

Water flow underground is much more commonly through porous rock masses, such as sand, gravel, and porous rock, than it is through channels or larger openings. Naturally the movement of the water through these strata is not rapid like the flow of a stream in an open cavern or channel. When water is drawn from such a source, the quantity which may be removed without depleting the supply is limited by the permeability of the rock through which the water approaches.

This last fact is the governing one which determines the practical rate of pumping of ground water in most localities. In a few cases overpumping not only depletes the supply of water, but introduces contaminants or changes the character of water supply. Atlantic City affords one interesting example of that character. Most of the resort-hotel water and the city supply at Atlantic City is now drawn from what is called the 800-ft. horizon. Formerly higher fresh water levels were used. They now have been destroyed by overpumping which brought contaminating salt water into areas previously salt free.

Safe Pumping Rates

In most areas actual experience with wells is used to gage the maximum proper water removal. That, however, is not always adequate. A much more reliable engineering method is required and is available as a result of government studies, principally the investigations of the Water Resources Branch of U. S. Geological Survey. The procedure recommended by it is based on the Thiem method, a German development of about forty years ago. That procedure of calculation is very concisely described in a survey report in the following language:

"The Thiem method for determining permeability of water-bearing materials consists of pumping a well, or, where the ground water is confined under pressure, allowing the well to flow and observing the decline of the water table or piezometric surface in nearby observation wells. The coefficient of permeability is computed by the formula

$$P = [527.7q\log(a_1/a)]/[m(s - s_1)]$$

where P is the coefficient of permeability; q is the rate of pumping, in gallons per minute; a and a_1 are respective distances of two observation wells from the pumped well, in feet; m, for artesian conditions, is the vertical thickness of the water-bearing bed, in feet; m, for water-table conditions, is the average vertical thickness, at a_1 and a, of the saturated part of the water-bearing bed, in feet; and s and s_1 are the drawdowns at the two observation wells, in feet. This formula is mathematically developed by assuming ideal geologic and ground water conditions, such as a uniform permeability, a uniform thickness of water-bearing bed, a horizontal water table or piezometric surface, and a cone of depression that has reached equilibrium in form. As these conditions are rarely approached, the applicability of the formula and hence of the method has been regarded as questionable."

Numerous tests using this method indicate useful reliability. But considerable experience is necessary in

Typical Analyses of Surface and Ground Waters in the United States

Parts per Million

	A	B	C	D	E	F	G	H
Silica (SiO_2)	2.4	12	10	9.4	22	13	3.0	19
Iron (Fe)	0.14	0.02	0.09	0.2	0.08	0.1	.....	.....
Calcium (Ca)	5.8	36	92	96	3.0	87	21	20
Magnesium (Mg)	1.4	8.1	34	27	2.4	41	4.0	2.0
Sodium (Na)	1.7	6.5	8.2	183	215	26	16	344
Potassium (K)	0.7	1.2	1.4	18	9.0	3.8		
Bicarbonate (HCO_3)	14	119	339	334	549	420	53	501
Sulphate (SO_4)	9.7	22	84	121	11	52	44	233
Chloride (Cl)	2.0	15	9.6	280	22	21	14	115
Nitrate (NO_3)	0.54	0.1	1.0	0.2	0.52	4.2	.....	.....
Total dissolved solids	31	165	434	983	564	456	135	1,008
Total hardness as $CaCO_3$	20	123	369	351	17	386	69	58

Equivalents per Million

Calcium (Ca)	0.29	1.80	4.59	4.79	0.15	4.34	1.07	1.00
Magnesium (Mg)	0.12	0.67	2.80	2.22	0.20	3.37	0.34	0.16
Sodium (Na)	0.07	0.28	0.36	7.96	9.35	1.13	0.70	14.96
Potassium (K)	0.02	0.03	0.04	0.46	0.25	0.10		
Total cations	0.50	2.78	7.79	15.43	9.95	8.94	2.08	16.12
Bicarbonate (HCO_3)	0.23	1.95	5.56	5.47	9.00	6.89	0.87	8.22
Sulphate (SO_4)	0.20	0.46	1.75	2.52	0.23	1.08	0.92	4.85
Chloride (Cl)	0.06	0.37	0.27	7.90	0.62	0.59	0.39	3.24
Nitrate (NO_3)	0.01	0.00	0.21	0.00	0.01	0.07	0.00	0.00
Total anions	0.50	2.78	7.79	15.89	9.86	8.63	2.18	16.31

(A) Catskill supply of New York City. (B) Niagara River, filtered for public supply of Niagara Falls, N. Y. (C) Wells 30-60 ft. deep for public supply of Dayton, Ohio. (D) Well 2,090 ft. deep for public supply of Maywood, Ill. (E) Well 330 ft. deep at Smithfield, Va. (F) Wells 45-95 ft. deep for public supply of Peoria, Ill. (G) Surface water for public supply of Dallas, Tex. (H) Well 2,500 ft. deep for part of public supply of Dallas, Tex. From USGS Water Supply Paper 658.

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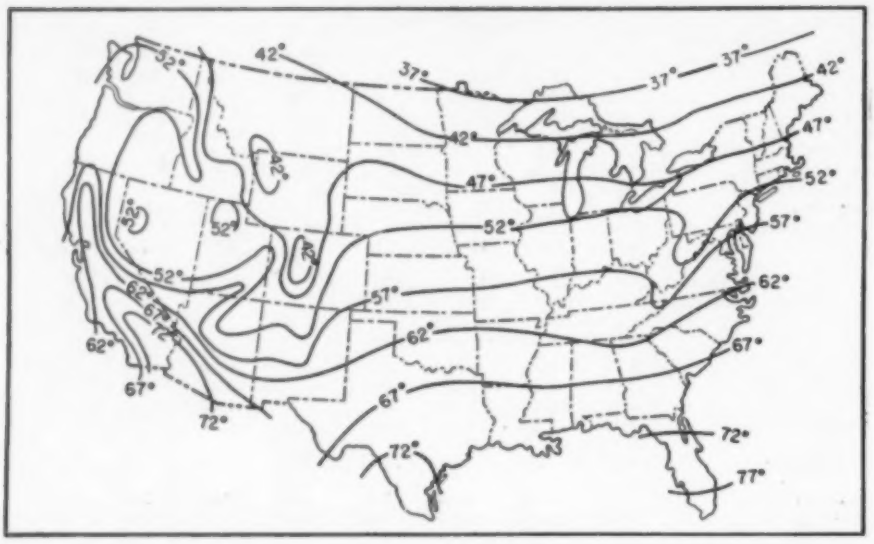


TEMPERATURE OF WATER, approximate, from non-thermal wells at depths of from 30 to 60 ft. It usually exceeds mean air temperature by 3 to 6 deg. F.

interpreting the observations and in applying this formula. The prospective draw-down of the water table at any reasonable distance from the well being worked is not always accurately shown from a series on a single well. But experienced water-supply engineers acquainted with the geology of any region obtain extremely valuable information from this formula. It serves very reliably in indicating proper well spacing on the average over an area, and is extremely helpful in forecasting safe aggregate water withdrawal rates. A number of the applications of this procedure by the survey staff have been published. One of the more interesting ones, because the report fully explains in detail the observations in a specific case, is a discussion of the Platte River Valley of Nebraska. (See U. S. Geological Survey Water-Supply Paper 679-A.) Another report by O. E. Meinzer is of more general significance. (Water-Supply Paper 638-C, "Outline of Methods for Estimating Ground Water Supplies.")

Restoring Ground Water

When ground-water supply wanes through over pumping, there are two possible remedies. Obviously one is to pump less locally and take water from a wider area. The alternative is to restore the ground supply by putting water back into the ground.

During the war period a group of chemical process industries of large importance to the war effort near Louisville, Ky., did so substantially over pump the ground-water reserves there. This Louisville situation was brought on largely by the huge new demand for condensing water to be used in the alcohol and synthetic rubber plants of the region, a water demand concentrated within a few square miles. Recharging of the water-bearing strata got perhaps its most spectacular publicity as a result.

Actually there were four remedies considered for Louisville, three of new supplies and the more simple remedy of lower usage. Relocation of wells over a wider area was the No. 1 remedy suggested. A pipeline to bring water from a more remote area was the second proposal. Recharging of the ground was the third. Only this No. 3 was attempted seriously because working with individual managements on water wastage it was found possible to cut back the demand from more than 60 million gpd. to the tolerable load of about 40 million. Thus recharging on any large scale became unnecessary.

Artesian Supplies

When the water table lies at a higher level than the ground there is, of course, a lake, or a river if runoff is practical. Where the water table would be above ground, but can not be because water is held between two impervious strata, then the supply of water makes possible either a spring or an artesian well. As a matter of fact, a spring is usually merely a natural artesian flow.

In almost all respects artesian conditions differ little in character from other ground-water supplies. They represent principally a condition where zero pumping is required to bring the water to the surface. But, contrary to the impression of the thoughtless person, the total quantity of water available from an artesian source is determined by the permeability of the water-bearing strata, just exactly as is the quantity of ground water which can be taken from pumped wells. Free-flowing wells have only the one major difference, they will not over-pump themselves.

Recharging Techniques

Methods for putting water back into the ground had been developed in the prewar period in quite a number of areas. More of this method is practiced in California than in all of the rest of the United States together. There seasonal rainfall is caught and distributed over "spreading areas." These are porous surface areas from which the water seeps into the ground quickly to supply needed water-bearing strata.

In numerous other places, most conspicuously on western Long Island, water is put into the ground through wells drilled particularly for that purpose. New York State laws require any industrial user of water in the counties of Kings and Queens to maintain ground supplies, if he takes more than 100,000 gpd. Hence the typical industry installation there is two wells, one to pump water into the plant and the other to pump water back into the ground. This recycling enables Metropolitan New York to be one of the three largest single users of ground water in a concentrated area without serious depletion. The other two areas of largest ground-water use are Greater Houston and Metropolitan Los Angeles.

Water-supply engineers with a national view believe that many other areas will find recharging of water strata is necessary in the near future. Obviously recharging can often be done seasonally, especially when the drawdown is seasonal and rainfall occurs in a different portion of the year. The alternative of bringing water from greater distances will, however, always be considered and a choice made on the basis of economics. But, obviously, economy in water usage is a still better choice to the extent possible.

Surface Water Supply

Far more water for various purposes is available in surface water than is drawn from underground sources in most areas. To indicate available supplies of such water, regular stream gaging and chemical sampling are carried out by the Geological Survey staff. Naturally the total of such avail-

able supply depends upon precipitation. But the correlation between rainfall generally, and stream flow at a particular point, requires consideration of the whole upstream watershed involved.

Quantity of water used to be the major consideration demanding attention on the part of those considering surface supply. They had to take account of low water periods and of flood problems. Now even more important in many cases is the question of the quality of water. Upstream contamination is indeed a controlling factor in a vast number of urban areas.

At this point in any water study for a particular plant or a particular area, the engineer is confronted with the whole problem of stream pollution, effluent control, and water purification. Those are extremely important subjects for process industry, but consideration of them is not practical in the present report.

Source and Treatment of the Public Water Supplies of the Larger Cities in the United States

Sources of Treatment	Number of Places	Population Served — Thousands	Population Served — Percent of Total Population
Surface water:			
No treatment other than chlorination	160	21,932	17.9
Coagulation without filtration	6	126	0.1
Filtration without coagulation	11	2,216	1.8
Filtration after coagulation	241	19,695	16.0
Filtration and softening	32	3,752	3.1
Total surface supplies	450	47,721	38.9
Wells less than 100 ft. deep, infiltration galleries, and springs:			
No treatment other than chlorination	64	2,223	1.8
Iron removal	13	391	0.3
Softening	3	203	0.2
Total shallow ground supplies	80	2,817	2.3
Wells 100 ft. or more deep:			
No treatment other than chlorination	119	5,473	4.5
Iron removal	16	575	0.4
Softening	5	110	0.1
Total deep ground supplies	140	6,158	5.0
Total ground supplies	220	8,975	7.3
Total supplies	670	56,696	46.2

Data for 1932 from USGS Water-Supply Paper 658.

Water Is Big Business

About 10,000 urban communities having 75 million population receive water from public supply systems. Two-thirds of the communities supplying 30 percent of this population use ground water.

Typically, ground water goes one-third to urban supply and two-thirds for industrial supply. Surface water supplies several times the gallonage for industry as is used in urban distributing systems. Only irrigation exceeds industry as a water consumer, and this is true only in the West. In irrigated areas supplied from ground water the irrigation demand is about twice that of industry. But this fact is true largely because irrigated areas are seldom highly industrialized. Competition between industry and irrigation consumption of water appears serious only in California.

Urban centers use ground water as little as possible because the cost is almost always greater than for surface water supply if there is an acceptable source of the latter nearby. There are only three urban areas where huge quantities of ground water are pumped. These are the Long Island section of Greater New York, Greater Houston, and Metropolitan Los Angeles. In each of those areas about 400 gpd. is pumped. Other pumping areas seldom reach 200 million per day. And most ground water demands even in large cities are of the order of 40 to 100 million. Any urban area that takes as much as 20 million of ground water is regarded as a significant consumer. Of course, many of these areas use much more water than this, since ground and surface waters combine to serve most of them.

Competition for Water

Competition for surface water has been the cause of bitter controversy. History of western legislation includes many cases in which the water rights of upstream and downstream interests were defined. Now the problem is much bigger and much more acute.

Congress has had to consider these problems on a national scale. It has on several occasions granted permission to states to prepare interstate compacts which define the rights of different areas to control and use both normal and flood waters. As a consequence, a water law has become crystalized and one can foreguess what his privileges may be.

Unfortunately those laws are of little help, usually of no significance whatsoever, for process industry. The competition into which our enterprises enter is far more local, and the relationships are not based on statute rights of a broad nature. Far more significant are local political considerations. Actually there has developed a set of water claimants for whom some sort of a priority system of water allocation has to be worked out.

Water Priorities

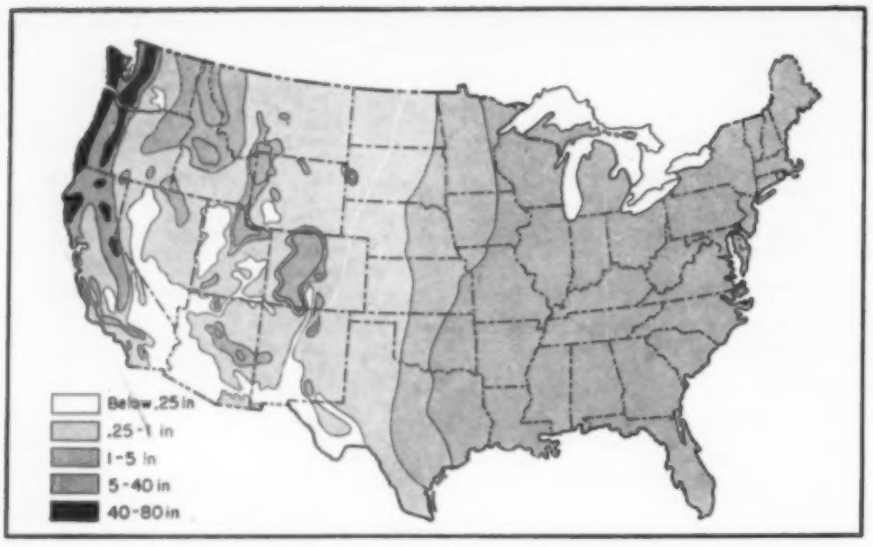
Nearly a dozen competitors stand in line at the water priority window whenever inadequate supply is being doled out. Generalizations as to who gets first or preferred service among the competitors is not safe except in one particular. Apparently no one denies that urban water supply for household and general sanitary purposes takes first place. That priority is, however, sometimes slightly modified by the proviso that the city under the guise of urban supply must not extend its services unduly for other purposes of lower rank.

Second rank claimants of water vary in importance according to the part of the country involved. In semi-arid regions of the West, irrigation is necessarily given high rating. In most areas east of the Missouri River that demand commonly rates a lower classification. Nevertheless, it is an important factor everywhere because food production by irrigation is becoming increasingly important.

Other features of food production also enter significantly in some areas. Maintenance of water flow on a basis to protect aquatic life is sometimes a matter of considerable interest in water assignment. This factor takes on strange forms in various locations. Two or three of these deserve note.

The Fish Problem

On the Columbia River system and on one or two less prominent western rivers the question of maintenance of the salmon industry depends on maintenance of conditions under which the adult fish may go upstream to spawn and fertilize the eggs, and also condi-



NORMAL ANNUAL RUNOFF. Stream flow and ground water studies furnish date necessary for utilization and regulation for both industry and agriculture

tions permitting the fingerlings safely to descend from their birth area to the sea where they will spend most of their life before being caught or returning years later to furnish another generation. On the Columbia one of the major limitations on power development of industrial enterprise has, therefore, been the question as to whether the salmon industry would not be destroyed by new power units. Partial but not complete solution of that problem has been achieved. It remains a question which may determine whether further development of the Columbia for power purposes goes forward or not.

On a number of eastern streams there are like problems affecting natural growth areas for fish, shell life, and other aquatic varieties. In some cases the regulation of stream flow, especially the reduction of water flow at low seasons, determines the salinity of breeding grounds, oyster beds, and other important water-life areas. Thus industry is confronted with the need of controlling its activity, lest it influence seriously quantity and temperature of water reaching such places.

Even more important, and of course better recognized, is the problem of prevention of such stream pollution as may destroy all this aquatic resource. That this is not an academic question is evident to anyone who considers the ways in which brass industry effluent on the Housatonic River system has completely destroyed certain parts of the seafood industries on or near the mouth of that stream.

As these factors of food supply become more important in the total national economy, we shall have more attention given to them, and perhaps correspondingly greater restriction on the activities of the industrial water users. For the present, however, the industrial water user rates usually about equal to, or sometimes a little above, the irrigation and food production claimants. The actual position depends on who is doing the rating and how much he is influenced by the Isaak Walton League or by his industrial leanings.

Further Competition

Almost universally, if one is a reasonably disinterested appraiser, he places on the priority list well below industrial use, irrigation, and food production the three other major water claimants. These desire water for navigation, for steam power (cooling), for hydro-power development, and for recreation or scenic development. However, nature-lover groups with large political influence are constantly bringing this factor of scenery and recreation in as a dominant consideration. No sensible engineer omits this factor; but he often wishes that it could be less exaggerated than it is in a few instances. As an offset for this exaggeration, it has become increasingly important that industrial development be so planned as to avoid destruction of recreation and other enjoyment opportunities associated with waterways.

Industrial users in this last group on the water claimant list include mining, steam-power development, hydro-power development, and navigation interests. Fortunately all of these can frequently work together and get a common benefit from proper stream treatment. For prevention of flood control the same procedures as serve this group are also often helpful, if not adequate. In all cases the maintenance of reasonably uniform stream flow throughout the year is a desired objective. That minimizes flood damage, increases base-load hydro-power production, and provides regular water supply for both navigation and cooling purposes. Fortunately it also may helpfully contribute to urban supply and industrial uses that are consumptive and not contaminating.

It is the fact that these several interests which might be competitive can often be made cooperative, that stimulates all-river system studies and encourages developments that are not merely spotwise or local in nature. Incidentally, industry must remember that its use of water for cooling, like the corresponding use in the steam-power-generating plant, may reduce the quality of the water for downstream applicants merely by raising the temperature. There is lately some disposition to view this factor as equivalent to that river contamination which chemically affects quality.

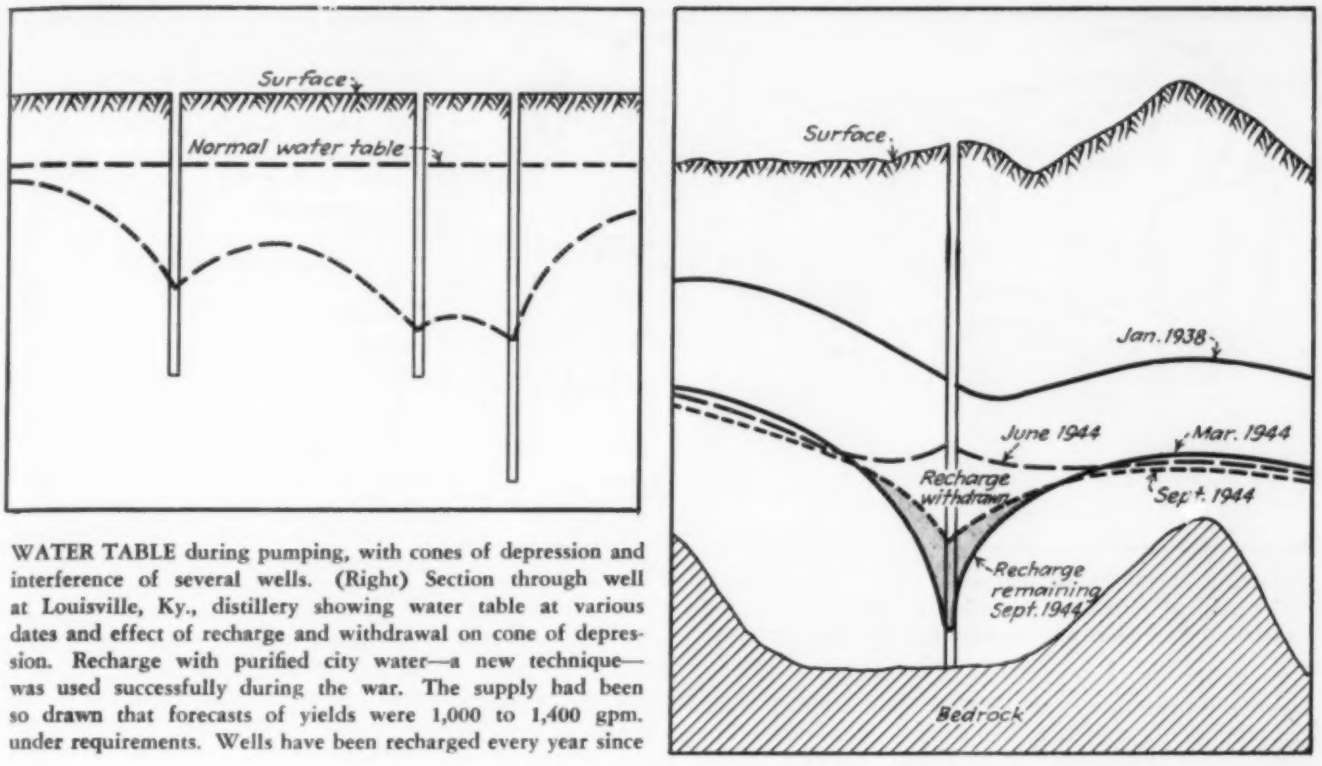
Water Analyses

Geological Survey engineers and chemists have been constantly alert in gathering every available fact that is a dependable indication of the chemical composition of either river water, ground water, or public water supply. These investigations date back many years to the classical study of Clark which discussed water supply throughout the United States in the famous USGS Professional Paper 135. Unfortunately, that document has been long out of print, but it is well worth consultation at any library which has it.

More recently survey studies have been made in cooperation with a number of states. Quite a number of very important bulletins have been issued jointly by federal and state officials. Most complete are the reports for Pennsylvania, Virginia, North Carolina, Georgia and Arkansas. Partial studies and corresponding information can be had on many other areas.

To bring this material together and make it most readily available promptly, the survey issues annually a summary in a water-supply paper called "Quality of Surface Waters of the United States." These bulletins are annual summaries for each year from 1941 on, but not including most of the war years for which data have not yet been fully compiled and published.

The most comprehensive available



WATER TABLE during pumping, with cones of depression and interference of several wells. (Right) Section through well at Louisville, Ky., distillery showing water table at various dates and effect of recharge and withdrawal on cone of depression. Recharge with purified city water—a new technique—was used successfully during the war. The supply had been so drawn that forecasts of yields were 1,000 to 1,400 gpm. under requirements. Wells have been recharged every year since

summary for the country as a whole is one which relates to conditions in 1932, published as USGS Water-Supply Paper 658 under the title "The Industrial Utility of Public Water Supplies in the United States."

It is of interest to note that the same group which publishes chemical analyses is also concerned with the studies on water temperature. This means merely that temperature is an important element of quality from the standpoint of the water user.

In this matter of temperature it is important to note the distribution between ground water and surface water. Ground water is practically uniform in temperature throughout the year when drawn from levels between 30 and 60 ft. below the surface. Surface water temperatures vary widely. Not uncommon are variations from barely above freezing to 85 degrees between winter and summer temperatures at the same point. Collins gives one of the most significant summaries on this question of water temperature in the following paragraphs of his Water-Supply Paper 520-F.

"The temperature of ground water available for industrial supplies is generally from 2 to 3 deg. F. above the mean annual air temperature if the water is between 30 and 60 ft. below the surface of the ground. At a depth of 10 ft. the temperature may range from 10 deg. above to 10 deg. below the mean annual temperature. An approximate average for the increase in temperature with depth is about 1 deg. F. for each 64 ft.

"The mean monthly temperature of a surface water at any place is generally within a few degrees of the mean monthly air temperature when the air temperature is above the freezing point. The maximum water temperature in any of the warmer months is usually from 2 to 6 deg. higher than the mean monthly water temperature."

Quality of Water

Process industry is often more concerned with quality of water than with any questions of shortage. Incidentally, it is quite often important to secure uniformity in quality quite as much as to have any particular property. In one case a large plant found it necessary to move from one side of a river to another, merely to get away from fluctuations in the composition of water supply in the first location. The new supply averaged less pure, but the uniformity permitted controllable plant operations which offset dollar-wise the lower purity.

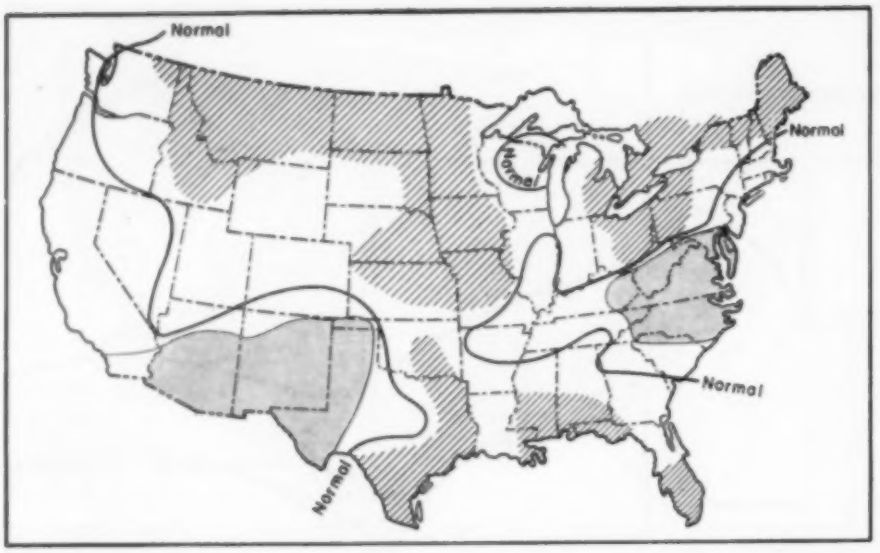
During the war period large-scale explosives manufacturers found it extremely important to watch this question of variable water supply. Where any salt might come, as in estuaries or rivers near the sea, a significant hazard developed if unusual traces of salt or other chloride were encountered. Some plants a full hundred miles from the ocean have had such experience. On one occasion during low river flow in the Potomac as much as 3,000 ppm. of salt have been found in this river as far up as Washington, D. C. Thus the long-time, as well as the spot problem of water supply and quality variation must always be considered.

Other Chemical Qualities

Where process water or boiler water is required, it is often most important to determine prospective hardness of water supply. In general, surface waters are less of a problem than ground water in this particular.

Where either natural contamination or industrial usage occur, the oxygen content or oxygen demand of a water supply is of equal, sometimes dominant, importance. This characteristic is, however, one which may vary widely with the seasons and may suddenly change as a result of upstream operations. It is also a characteristic that is most often a subject of controversy, especially by the Isaak Walton Leaguers who rightly object to such changes of conditions as destroy fish life.

As yet there are no general surveys indicating expectable oxygen content or oxygen characteristics of natural waters. But no modern laboratory will make a water analysis which does not



STREAM FLOW for the 1947 water year. In shaded area flow was among lowest 25 percent of record for the year; in crosshatch area flow was among highest 25 percent. The year was characterized by excessive runoff over broad regions

identify the oxygen characteristics of the sample. Of course, in many cases these characteristics have to be determined in the field, as samples often change in this characteristic in transit to the laboratory.

Convenient Units

Water supply is measured by a variety of units, each chosen because of its peculiar application for special purposes. For convenience in judging water problems it is of interest to note the interrelation of some of these.

A stream measurement of one second-foot will deliver per day 646,000 gal. of water. And that quantity of water equals 1.98 acre ft., that is water over that acreage 1 ft. deep. Hence it is convenient to remember that a stream flow of 1 sec.-ft. provides 2 acre ft. per day, a relationship quite as accurate as any ordinary water flow measurement.

A small creek commonly flows at the rate of 30 or 40 or 50 sec.-ft. And this rate of flow is not very heavy because stream flow measurements are made by wading in any stream flowing at such a rate, even a stream flow of 100 sec.-ft. in common practice. Incidentally a stream flowing at 6 ft. per sec. is traveling only 4 mph. Flood stage flow on streams is seldom more than 10 to 15 mph.

A tremendous range in rate of stream flow is commonly observed on most rivers and streams. At Washington, D. C., the Potomac for example had a minimum flow of 448 sec.-ft. in August 1930. At flood stage it reached 484,000 sec.-ft. in March 1936. But that ratio of 1,000 to 1 is by no means extreme. Little Rock Creek which runs down through the heart of Washington, D. C., flows at 0.5 sec.-ft. minimum. Its recent recorded maximum was 4,500 sec.-ft., substantially 10,000 times its minimum.

The natural flow of large wells is often amazing when one considers that the source of supply is merely a porous rock mass. Recently U. S. Geological Survey reported a natural flow of 25 million gallons per day from one well near San Antonio, Tex. This ground water used for steam power cooling represents an adequate supply from a single well of enough water for a small city. Only eight such wells would be needed to meet the maximum requirements of Washington, D. C. But that well is not a puny thing. It is a drilled well 24 in. in diameter and 1,052 ft. deep. Naturally the average process industry cannot expect the good fortune to get such flow in any but the most unusual local circumstances.

FLUCTUATIONS of the ground water level are recorded by automatic water-stage recorders on observation wells

Reference Material

Mentioned several times was the availability of valuable reference material in publications of U. S. Geological Survey. Nowhere else is there such a large library of valuable material to guide in water-supply studies. One of the most interesting documents because of its general usefulness is Water-Supply Paper 992, which is a bibliography of the other publication of USGS.

In several places above there are mentioned the specific reports that deal with industrial water, chemical analysis, water temperature, and like subjects. Those are important for background use. Much more helpful in specific cases are the intimate studies which report in detail on specific localities. Some hundreds of such reports have been prepared and are available, either in pamphlet form or for consultation at convenient locations. No engineer should go far in investigating the water problems of any area until he has asked the survey to tell him what they already have done in that locality. Frequently he will find many, if not all, of the basic facts which he needs readily available for the asking. Incidentally, however, the average chemical engineer may not be too successful in the interpretation of or the application of such facts. Water-supply engineering is a difficult art, one in which a specialist is often needed before a final decision involving large investment can safely be made.

The editors of *Chemical Engineering* acknowledge the helpful assistance given by the staff of U. S. Geological Survey, both in information for this report and for illustrative material. The staff of the survey is exceptionally able in advising both on the national problem and on any local or regional project. Readers having such problems will do well to consult them, either directly or through the water-supply consultant handling such problems.

Reprints of this report are available at 35 cents per copy. Address the Editorial Department, *Chemical Engineering*, 330 West 42nd St., New York 18, N. Y.

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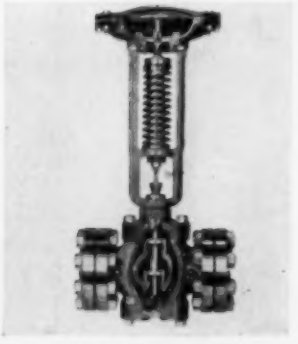

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"Chem & Met"

PICTURED FLOWSHEET

De-Inking Mill

AN IMPORTANT part of the modernization program of the Newton Falls Paper Mill, Inc., is the recently developed de-inking process which is based on the use of sodium peroxide. Improvements were made also in handling of raw materials, sulphite pulp preparation, machine room, finishing and shipping departments.

Briefly, the de-inking process consists of treating waste paper with peroxide and caustic in a hydrapulper. It is then subjected to a mild cook. The stock is passed over a riffler, screened, washed and bleached. After a final wash the stock is ready for the paper machine.

Bales of paper, hot water, sodium peroxide and caustic are charged into a hydrapulper. Hydrated slurry is pumped to cooking tank and treated until all ink is removed. It is then passed to the black stock storage chest where water is added to obtain a consistency of 4-5 percent. The stock goes to a stuff box and the consistency is reduced to 0.8-1.0 percent. After passing over the rifflers the stock passes by gravity onto flat screens. Acceptable stock leaves these screens and passes over a vacuum washer. From the washer it goes to a stock breaker, over two cylindrical washers covered with rubber couch rolls. A screw conveys washed stock into a mixing tank. Here hypochlorite bleach liquor is added through a rotameter.

From the consistency regulator stock passes to the tile-lined stock chest where it is held to permit completion of bleaching action. Bleached stock is passed over a cylindrical washer. De-inked stock is then blended with new sulphite pulp at a consistency of 4 percent. After blending, such materials as dyes, rosin size and alum are added and thoroughly mixed. The stock is diluted to 3 percent and pumped through a blending dump chest, consistency regulator, jordans and to the maching storage duct. Next the stock goes to Dirtec units for removal of dirt particles and to the head box of the fourdrinier paper machine.

Paper in rolls is conveyed from the machine to the Waldron micro-jet coater where it is coated first on one side and then on the other. After each coating the paper web passes through a straight pass tunnel dryer. Temperatures of the oven are graduated between 220 and 150 deg. F.

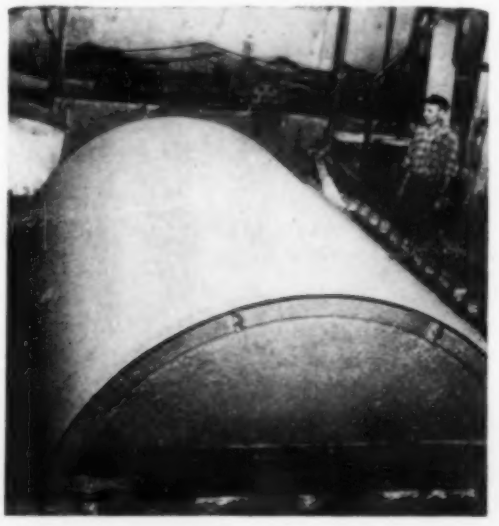
Paper leaves the dryer, forms a loop, the height of which is controlled by electric eyes, and passes to a tension stack, thence to the rewinder. When both sides have been coated rolls are conveyed to the super-calender. The uniform finish developed on both sides by the calender is done by means of a continuous constant-reading electronic glossimeter.

For a more detailed account of the de-inking process and the other improvements in the mill see pp. 106-109 of this issue.

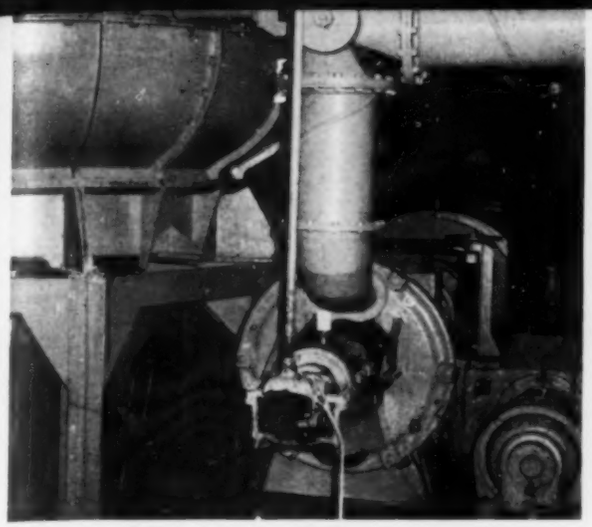
CHEMICAL ENGINEERING
January, 1948
PAGES 146-149

1 Waste paper is hydrated in hydrapulper with sodium peroxide, caustic and hot water

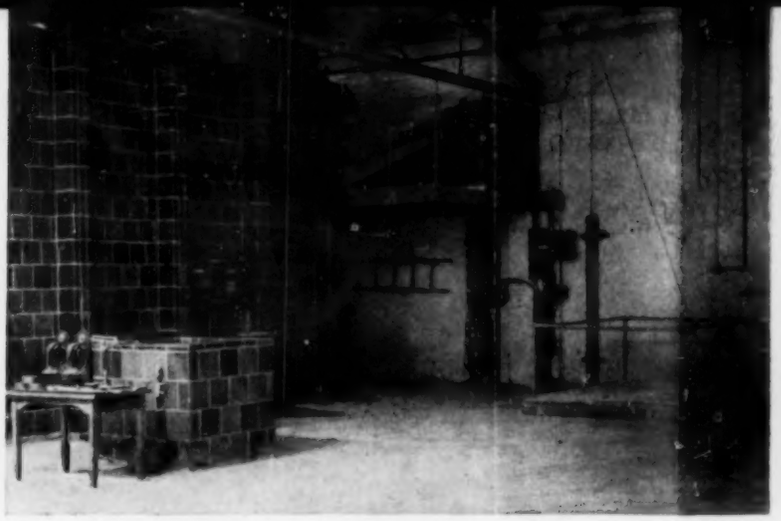
2 In cook tanks pulp is circulated by high-speed pumps. One turn-over every 6 min.



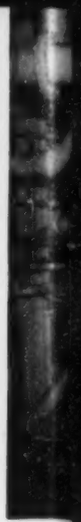
3 From screens stock passes over vacuum washer and then goes to a stock breaker



4 Sulphite pulp is treated in hydrapulper and later circulated through hydrafiner



5 De-inked stock is brought together with new sulphite stock in the blending chest. On right is opening to sulphite developing chest



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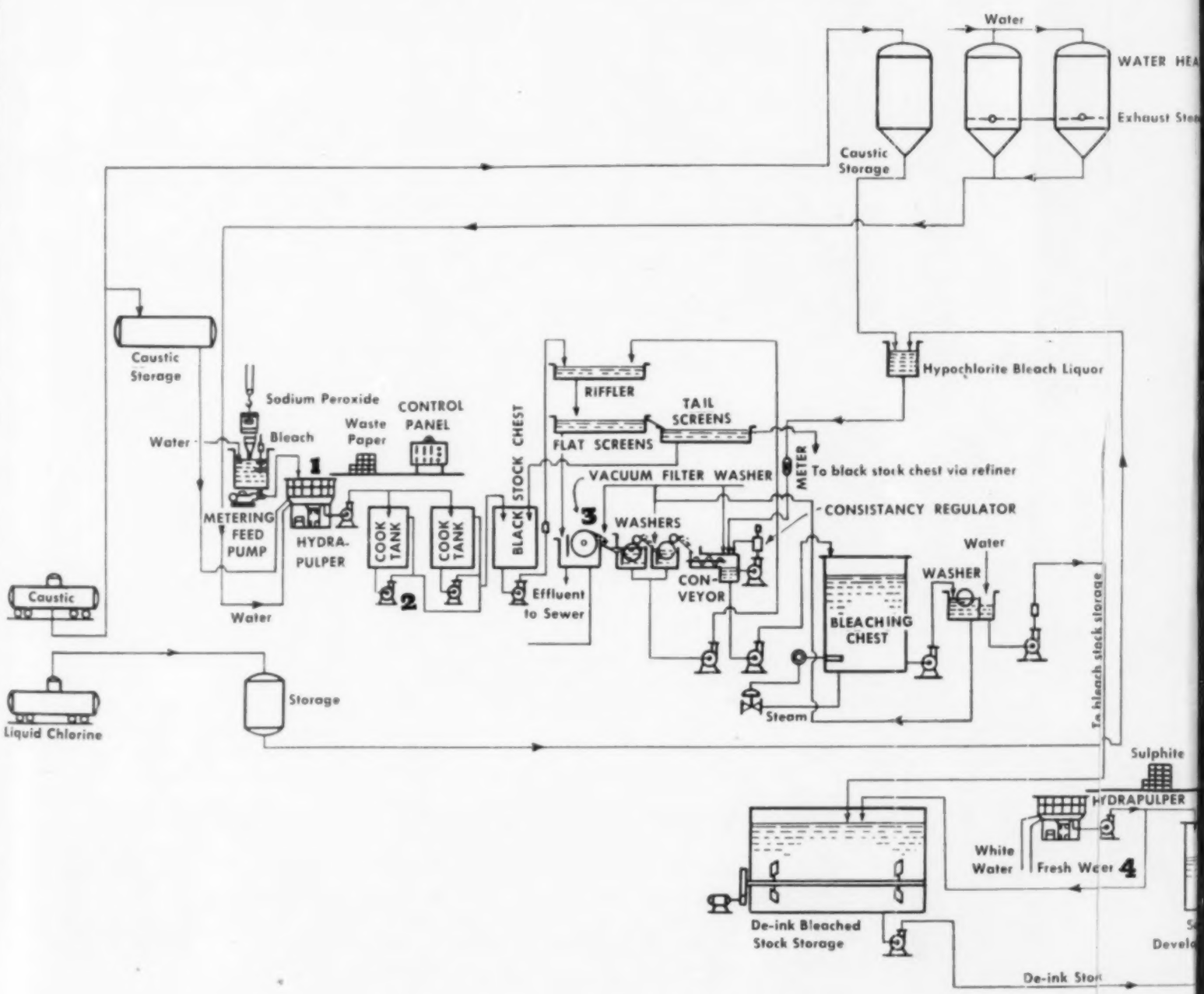
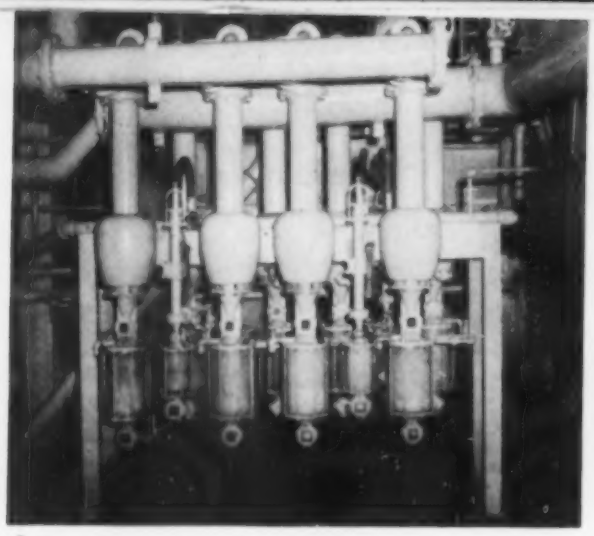
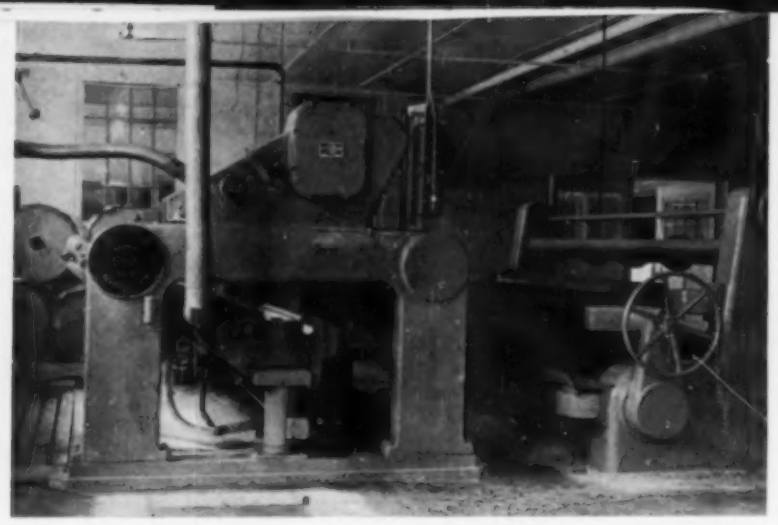
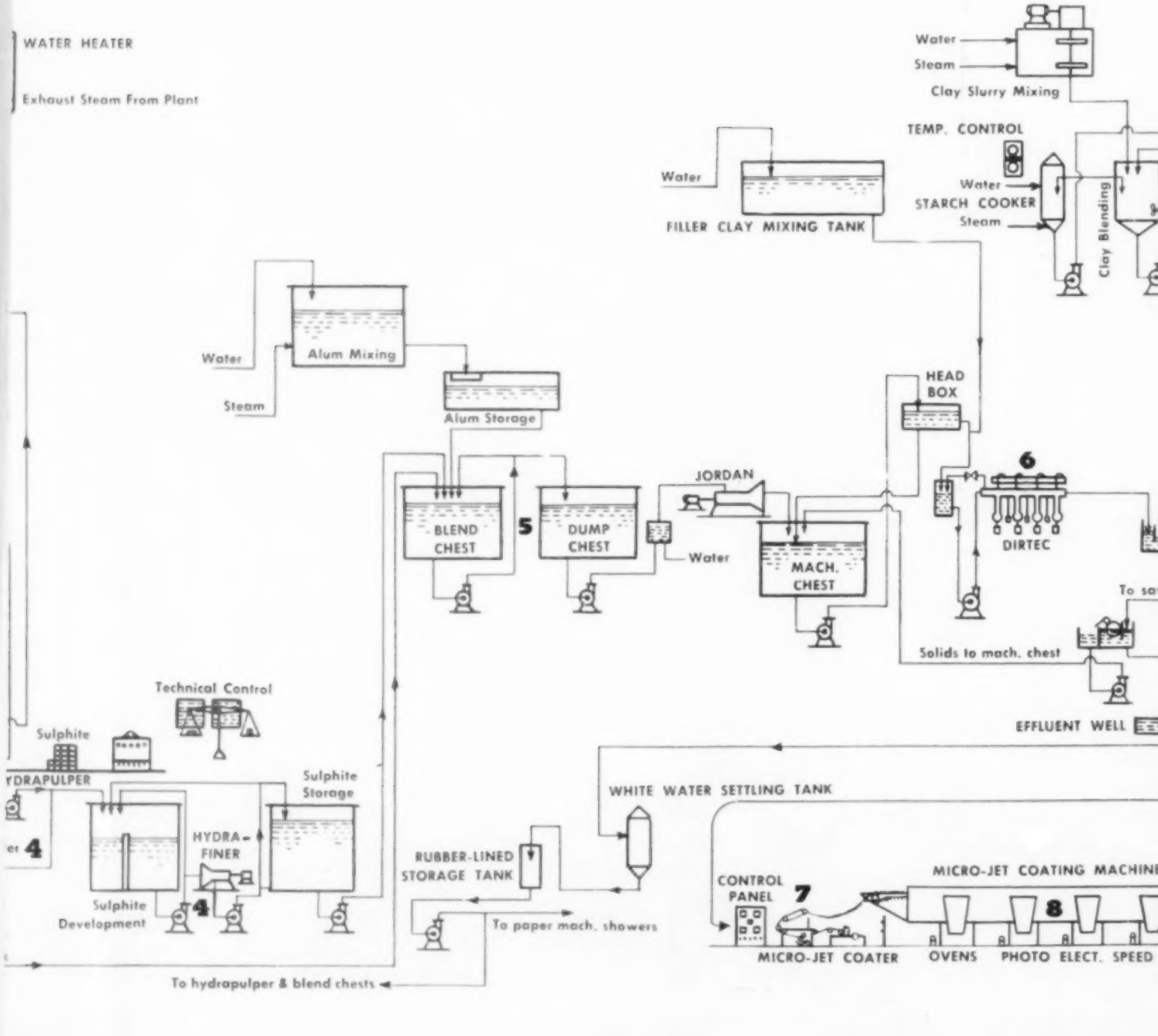




6 Stock goes to Dirtec units where dirt particles are removed before going to head box



7 Paper is coated on micro-jet coaters. Shown here is wet end with air knife and electric eyes. Eyes maintain height of paper loop at constant level



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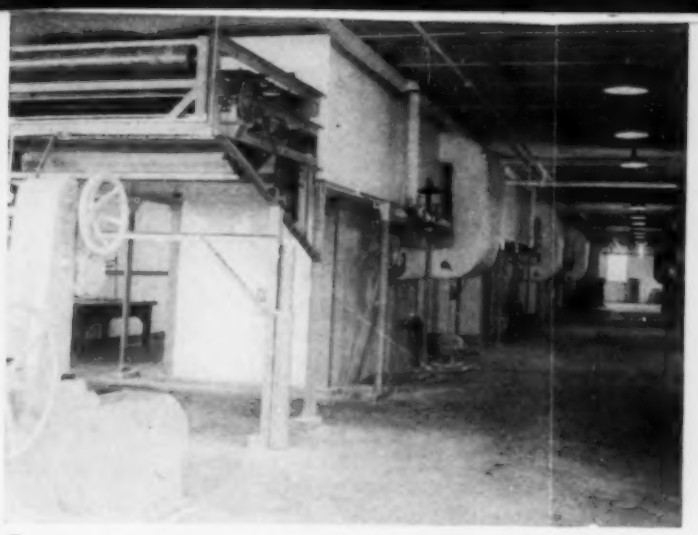
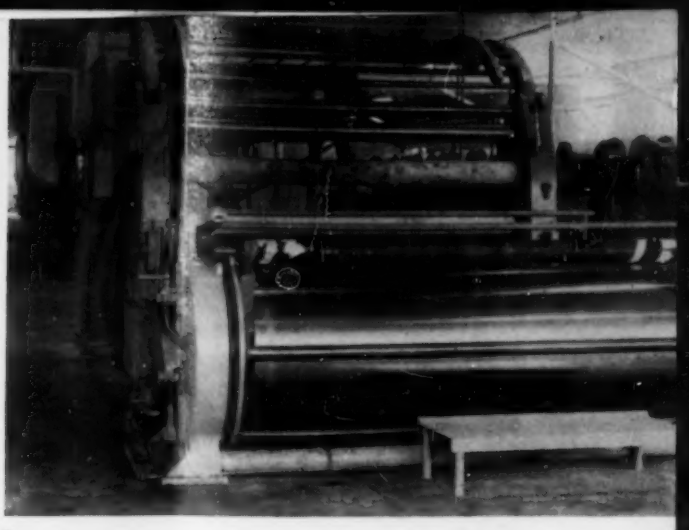
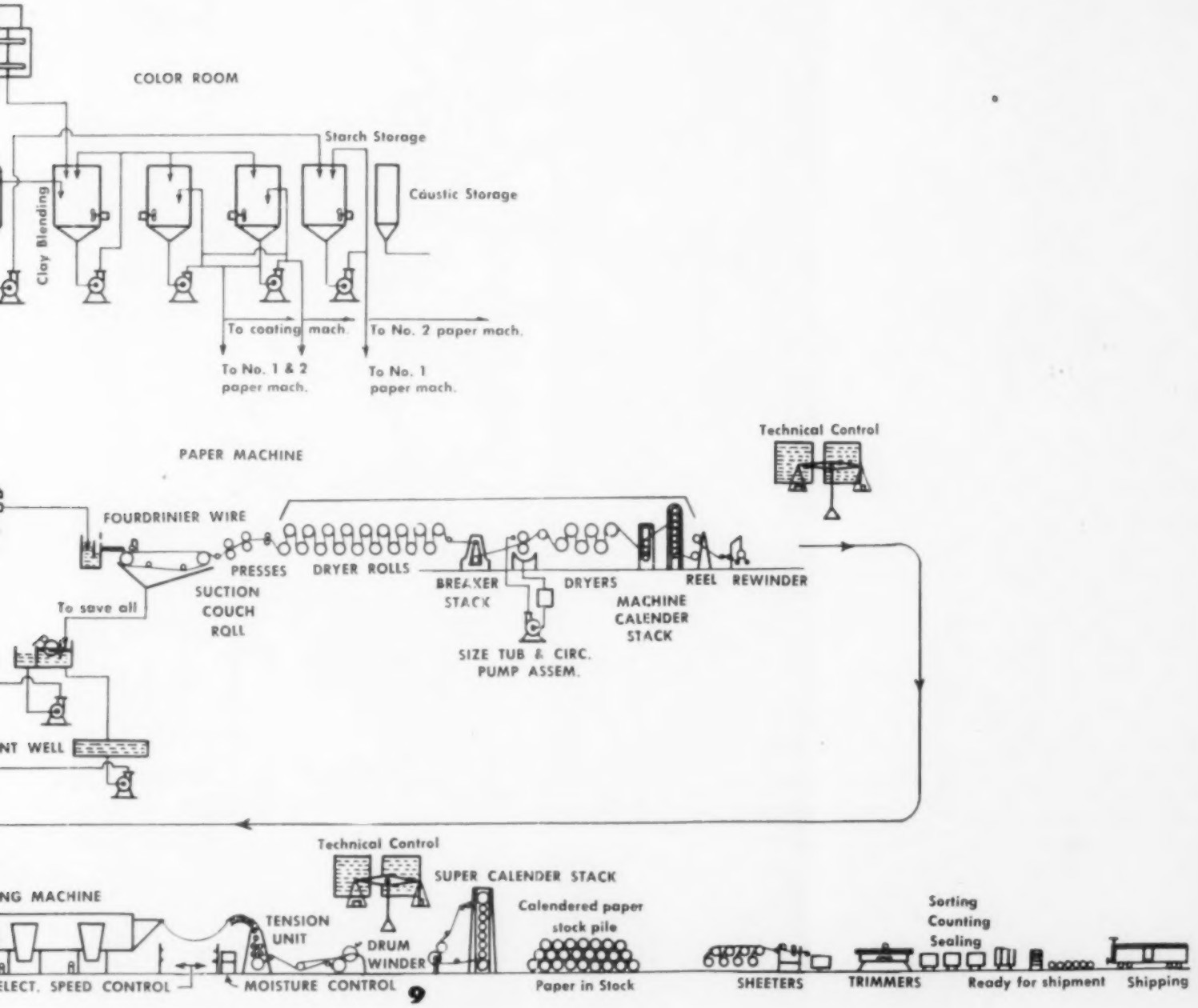


8 Paper web passes on flat level conveyor through straight pass tunnel dryer at 1,000 ft. per min.



9 On leaving dryer paper passes to rewinder. Moisture in paper is controlled by Moistograph shown on left



9

Catalysts by Baker...

SUPREME TEST OF UNIFORMITY

Baker, for nearly half a century, has been known for its analytical control of reagent chemicals. *The actual analyses on the labels* of these laboratory chemicals have shown, year after year, higher and higher degrees of purity.

The making of catalysts for industry differs in one respect. Purity is not always the only important factor. But uniformity to a pre-established quality from lot to lot and strict accuracy of analysis are vital.

For catalysis is a delicately balanced and painstakingly achieved process. Once the chemical composition is determined, adherence to specifications must be rigid, permanent, and uncompromising.

The J. T. Baker Chemical Company has been privileged, over a period of many years, to supply, uninterruptedly, chemicals especially prepared for catalytic application. These catalysts have been used in many of the nation's leading industries—industries such as plastics, the vegetable, oil and fat industries, organic solvent producers, petroleum chemical manufacturers, synthetic rubber producers and others.

To protect the interests of the customer, many of these chemicals are made on a confidential basis. Many are even code-numbered for the customer's protection. But all have one thing in common—so important to a manufacturer who needs a catalyst. The day by day and lot by lot analyses meet the supreme test—uncompromising uniformity.

If you need chemicals for catalysis, or any application where predetermined standards of purity are required, the J. T. Baker Chemical Company invites you to discuss your requirements with them in confidence.

J. T. Baker Chemical Co., *Executive Offices and Plant*: Phillipsburg, N. J, *Branch Offices*: New York, Philadelphia, Boston and Chicago.

Baker's

Baker's Chemicals

Baker's

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For faster, better piping jobs get everything from CRANE

An all-Crane installation! That's a sure way to keep piping jobs moving swiftly and smoothly—from design to erection to maintenance. Crane quality throughout—in valves, fittings, pipe, accessories, and fabricated piping—makes dependable performance a foregone conclusion.

ONE SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

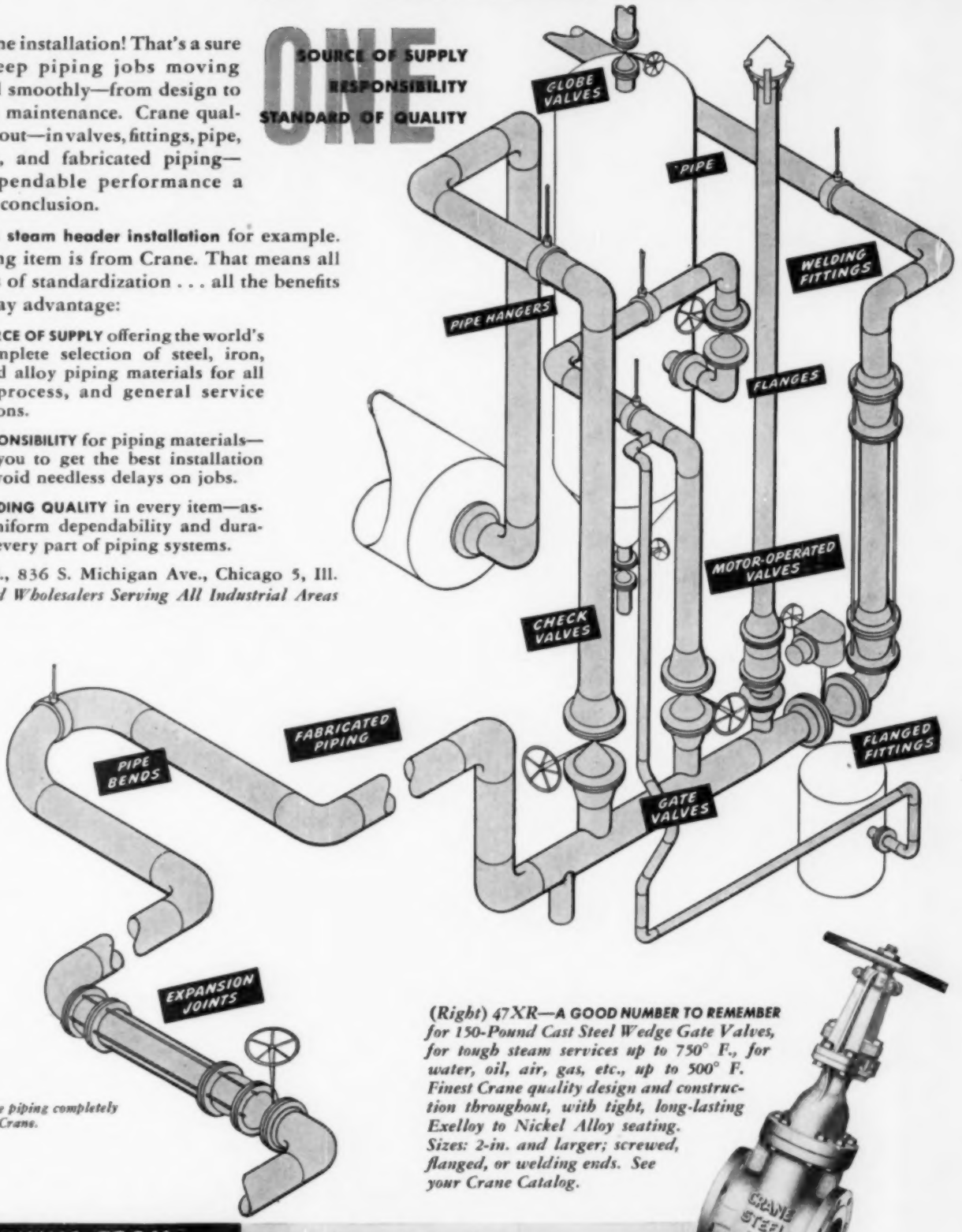
Look at this steam header installation for example. Every piping item is from Crane. That means all the benefits of standardization . . . all the benefits of this 3-way advantage:

ONE SOURCE OF SUPPLY offering the world's most complete selection of steel, iron, brass and alloy piping materials for all power, process, and general service applications.

ONE RESPONSIBILITY for piping materials—helping you to get the best installation and to avoid needless delays on jobs.

OUTSTANDING QUALITY in every item—assuring uniform dependability and durability in every part of piping systems.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



Steam service piping completely equipped by Crane.

(Right) 47XR—A GOOD NUMBER TO REMEMBER for 150-Pound Cast Steel Wedge Gate Valves, for tough steam services up to 750° F., for water, oil, air, gas, etc., up to 500° F. Finest Crane quality design and construction throughout, with tight, long-lasting Exelloy to Nickel Alloy seating. Sizes: 2-in. and larger; screwed, flanged, or welding ends. See your Crane Catalog.

EVERYTHING FROM . . .

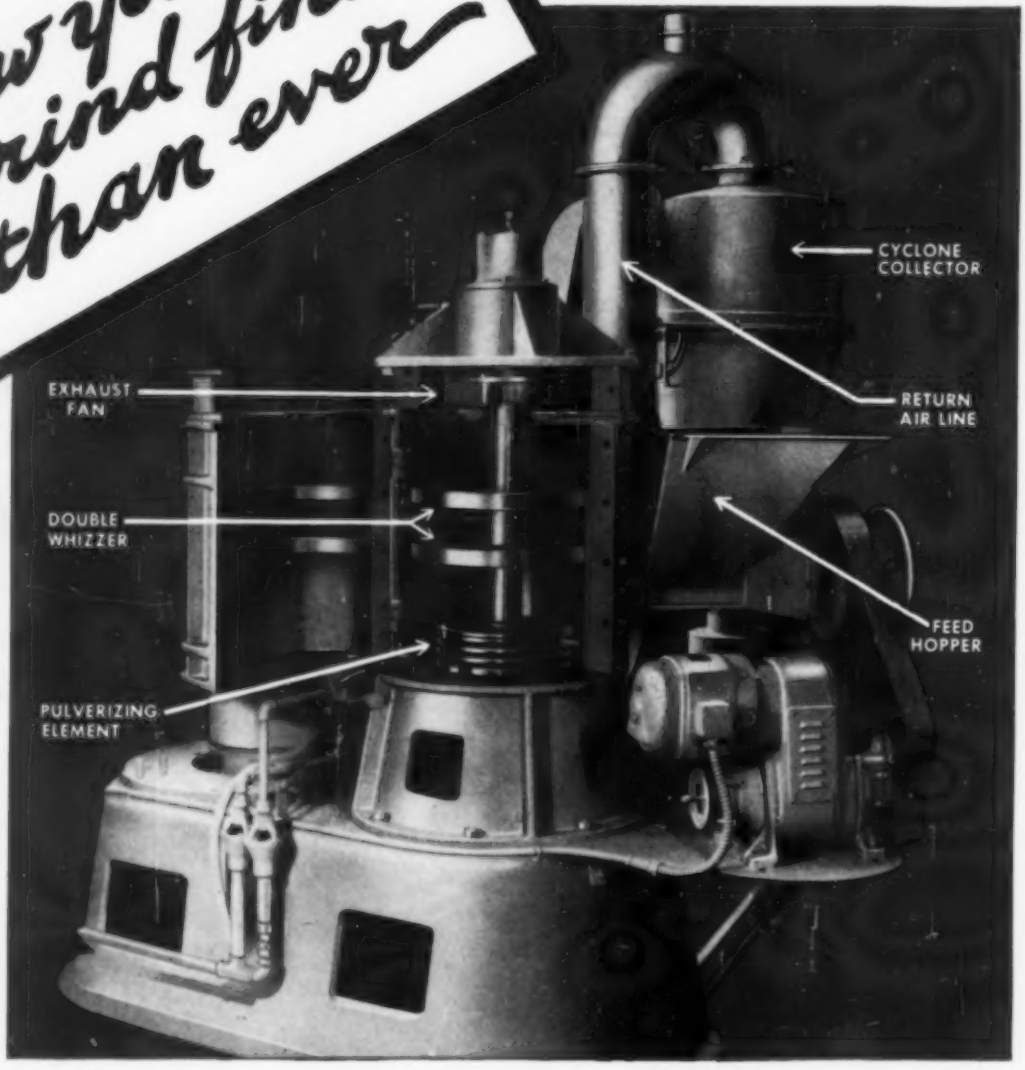
VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

RAYMOND VERTICAL MILL

Now you can grind finer than ever



Made in two sizes, 18" and 35" diameter for different capacity requirements. Write for Vertical Mill Bulletin No. 57

Here is another step forward in Raymond pulverizing equipment . . . the Vertical Mill that reaches a new high in fine grinding beyond the range of the standard mill. It takes over where the ordinary mill leaves off . . . producing extremely fine and uniform particle sizes, all passing 325-mesh.

If your specifications call for a fineness up to 95% to 99% finer than 5 to 10 microns, then the job may well be "made to order" for the Vertical Mill. It is specially adapted for handling soft, non-abrasive materials like chemicals, colors, graphite, talc, clays, vermiculite, limestone and similar materials.

This mill is complete with air separating equipment, incorporating the whizzer principle of classification which insures close control over particle size.

COMBUSTION ENGINEERING COMPANY, INC.

RAYMOND PULVERIZER DIVISION

1311 NORTH BRANCH ST., CHICAGO 22, ILLINOIS

SALES OFFICES IN PRINCIPAL CITIES

CANADA: COMBUSTION ENGINEERING CORP., LTD., MONTREAL

SINCE 1887

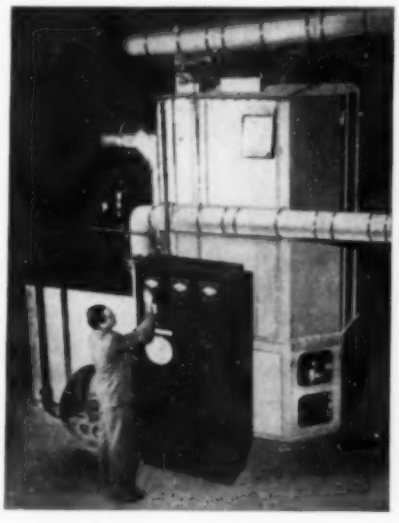
PROCESS EQUIPMENT NEWS

Theodore R. Olive, ASSOCIATE EDITOR

1. Heat Supply Machine

FOLLOWING several years of extensive use of nitrate-nitrite salt mixtures for the transfer of high temperature heat in the petroleum industry, Bethlehem Foundry & Machine Co., Bethlehem, Pa., has introduced a "packaged" heat supply machine for the production of temperatures in the range from 400 to 850 deg. F., using a mixture of this type as the heat transfer medium. Development of the equipment has been carried out with the cooperation of engineers of the Du Pont organization, which developed the particular eutectic salt mixture employed. The mixture, formerly known as HTS (for Heat Transfer Salt) is now known as Hi-Tec.

First of the "packaged" units to be built was presented on Dec. 9 by the



Bethlehem concern to the chemical engineering department of Lehigh University, and it is this installation that is shown in the accompanying view. The unit consists of a molten salt supply tank, an oil-fired, water-tube-type heater, and the necessary auxiliaries and controls. The salt mixture melts slightly below 290 deg. F. so that prior to use it is stored in molten condition in an insulated tank supplied with steam coils or electric heating units. After the heater has been fired the molten mixture is pumped through the heater tubes by a submerged centrifugal pump installed in the storage tank. Controls are provided to recirculate the mixture until it reaches the temperature of use. It is then pumped to the coils or jacket of the user, where extremely close temperature control can be secured by controlling the burner and the amount of recirculation.

The unit is completely instrumented to provide for full automatic operation and to take care of all contingencies that may arise. It is expected to be available in capacities in the range from 500,000 to 2,500,000. B.t.u. per hr. Also it is understood that special designs will be available for operation at temperatures above 850 deg. F., to 1,000 deg. or even higher. Below 850 deg. the salt mixture is said to be entirely non-corrosive to carbon steel, and to show no deterioration. At higher temperatures stainless steel must be used, and gradual salt loss through breakdown must be replenished.

Among the advantages mentioned for the new heating method is the fact that the system operates on a liquid of low viscosity, rather than a vapor, and hence requires only negligible pressures. There is no special hazard from explosion or toxicity, and good heat transfer is claimed, so that it is possible to use low temperature differentials between the transfer medium and the material being processed.

CONTENTS

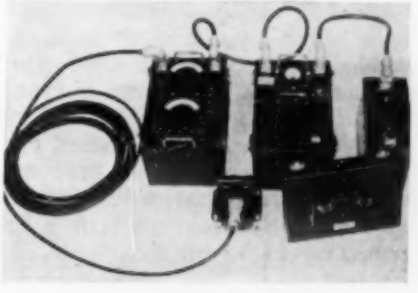
Heat Supply Machine 153
Thickness Gage 153
A. C. pH Meter 154
Analysis Unit 154
Humidity Element 154
Hydraulic Closer 154
Plastics Tester 154
Large-Area Filter 154
Moisture Meter 154
Pressure Fans 156
Cylinder Heater 156
Corrosion Resistant Fans 156
Pneumatic Conveyor 156
Continuous Rayon Spinning 156
Intensive Mixer 158
Pipe Intersection Compass 160
Hydraulic Transmission 160
Backing Plate 162
Improved Hose Valve 162
Pneumatic Transmitter 164
Condensate Return 164
Magnetic Pulley 164
Fire Extinguisher 166
Nylon Filter Cloth 166
Cullet Washer 166
Magnetic Separators 166
Insulation Strapping 166
Fire Wetting Agent 166

FOR MORE INFORMATION

See Reader Service Coupon on pages 169–170

2. Thickness Gage

INDICATIVE of the new trend towards instruments for measuring corrosion and wall thickness from one side of a metal surface only, is the Electroflux thickness gage introduced by Scott Electroflux Co., Waltham, Mass. Several principles have been employed in such instruments. The one currently described depends on electrical conductivity, employing an electrode head containing four electrodes forming a square. If such an electrode is placed on a metallic plate and a current is passed between two adjacent electrodes, the potential difference between the other two will depend on



the electrode spacing and the plate thickness. If two successive sets of electrode spacings are used, with spacings of S and 2S respectively, the ratio

between the values of potential obtained will be a function of the plate thickness, independent of the kind of conducting material being tested. The solid or fluid contents of the equipment has no effect on the thickness measurements. The method is said to detect lamination and to be capable of an accuracy of plus or minus 3 percent of the actual thickness.

3. A.C. pH Meter

CONVENIENCE of line operation from any a.c. line is available in a new portable glass-electrode pH meter offered by National Technical Laboratories, 820 Mission St., South Pasadena, Calif. Designated as the Beck-

man Model H, the instrument is said to have an accuracy of 0.03 pH units (or 2 millivolts). Standardization with a single buffer gives accurate measurements over the full instrument range. The instrument is provided with a built-in temperature compensator which can be set at the temperature of the test sample, eliminating the necessity for calculations or reference to pH-temperature charts.

4. Analysis Unit

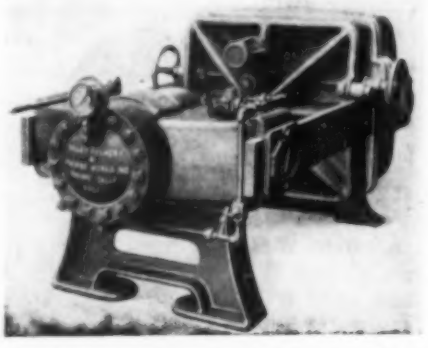
QUANTITATIVE determinations of the purity of metals or the percentages of alloying components, and quantities of metallic elements dispersed in non-metallic carriers, can be accomplished by a new X-ray diffraction technique employing a Geiger-counter fluorescence analysis unit offered by North American Philips Co., 100 East 42nd St., New York, N. Y. The unit consists essentially of an X-ray generator, a rotating indexing holder for four specimens, a simple collimating system, a crystal, a goniometer graduated from 0 to 90 deg., and a Geiger counter. The apparatus serves for determination of elements ranging from atomic No. 20 to 41 when a rock salt crystal is used, and for elements 42 to 50 with a calcium fluoride crystal. The new method is said to permit rapid analysis without destroying the specimens used.

5. Humidity Element

ACCURACY of plus or minus 1½ percent relative humidity in the range from 7 to 100 percent relative humidity is claimed for a new humidity sensing element, offered by American Instrument Co., Silver Spring, Md. This element employs a hygroscopic film, assembled in a sturdy housing, which changes its electrical resistance instantly with microchanges in moisture content. The element is small in size, responds in less than 1 sec. to either decreasing or increasing relative humidity, and is said to detect changes as small as 0.1 percent relative humidity. It may be used for remote installations, to indicate, record or control.

6. Hydraulic Closer

IN ORDER to facilitate the closing of the large model filter presses manufactured by Valley Foundry & Machine Works, Fresno 18, Calif., this concern is now offering a streamlined hydraulic closing device which eliminates the conventional gear and ratchet and is said to prevent excessive drip while closing presses. The device includes a steel piston with special hy-



draulic cups, operating a ram within a large two-way acting cylinder. A three-way, slide-action, lever-operated valve forces the hydraulic fluid to each end of the cylinder. One stroke of the lever diverts the hydraulic fluid on the opposite side of the piston and retracts the ram to open the press. A preliminary closing pressure of approximately 25 tons can be built up by actuating the ram with either a small pump or the pressure of ordinary water supply.

7. Plastics Tester

DESIGNED primarily for precision testing of plastics, rubber, non-ferrous metals, fibers and similar materials is

a new type of Baldwin-Tate-Emery testing machine produced by the A. H. Emery Co., Stamford, Conn. Unlike larger machines which employ hydraulic loading systems, the new machine uses a mechanical screw system. It features a continuously variable 400-to-1 positive speed range, great horizontal rigidity, complete elimination of backlash, and high accuracy even in the lowest ranges. Maximum capacity is 5,000 lb.

8. Large-Area Filter

AS A RESULT of a newly developed butt-welding technique, the Micro Metallic Corp., 193 Bradford St., Brooklyn 7, N. Y., is now prepared to provide porous stainless steel filter media in large sheets of any required area. This is accomplished by joining together 6 x 18 in. unit sheets, employing a modified form of Heliarc welding which is said to be particularly applicable when the filter material is 0.100 in. or more in thickness. Many special shapes can also be welded from ⅛ in. thick material. In addition to producing filter sheets of any area, this concern can now weld the porous material to solid stainless steel members, such as in closing rings, flanges, etc. The weld-assembled sheets can be sheared, drilled and machined, and within limits can be rolled and drawn.

9. Moisture Meter

REPRODUCIBILITY of results comparable with that of oven-testing (which is said to have an inherent error of 1 or 2 percent) is claimed for the new moisture meter offered by Thwing-Albert Instrument Co., Penn St. at Pulaski Ave., Philadelphia 44, Pa. The instrument is battery-operated and measures the resistance to the flow of an electric current through the sample being tested. The current flow through the meter is amplified by an electronic circuit and the readings are indicated on a scale directly

Why use two stages when ONE will do?

Fairbanks-Morse Single-Stage, Split Case Centrifugal Pump—for dependable, high-speed service.

When your job demands a multi-stage pump, the Fairbanks-Morse pump expert will recommend the right one from among the broad line built by his company . . .

But—frequently he can help you save the cost of a more expensive unit by recommending one of these single-stage, split-case pumps . . . whose performance, where heads reach toward 300 feet and capacities range to 72,000 g.p.h., is often equal to that of more costly multi-stage pumps.

Without prejudice, he can find for you the pump that suits your needs best; for in the Fairbanks-Morse line, he has all types, all sizes.

When it comes to pumps...

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MOTORS • GENERATORS • PUMPS • RAILROAD MOTOR CARS and STANDPIPES • FARM EQUIPMENT • MAGNETOS

A FEW OF THE COMPLETE LINE OF FAIRBANKS-MORSE PUMPS

Trash Pumps

Side-Suction

Rotary

Builtogether

in percentage moisture. The meter is calibrated by weighing the material to be tested, then measuring its electrical resistance. This process is repeated with varying amounts of moisture, until the range of the instrument has been covered. The zero of the scale is based on the electrical resistance of the material while in an oven-dry condition. The device is said to be suitable, with proper calibration, for determining percentage moisture in paper, wood, textiles and a variety of chemicals, with standard calibrations from 4 to 50 percent. However, ranges can be extended in either direction, if necessary.

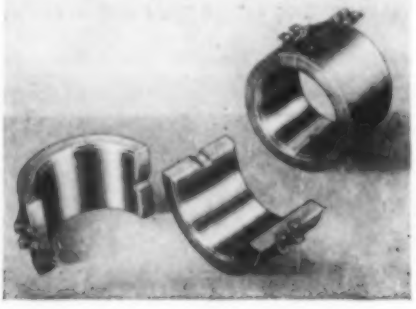
10. Pressure Fans

BOTH STRAIGHT-THROUGH and convertible elbow types are available in a new line of Axiflo fans announced by the Sturtevant Division of Westing-

house Electric Corp., Hyde Park, Boston, Mass. Both types are produced with either three-bladed aluminum alloy wheels or eight-bladed steel wheels. Drying, processing, air-conditioning and dust removal are suggested applications. Fans vary in size from 18 to 72 in., for static pressures up to 3 in. and displacements from 2,000 to 115,000 cfm.

11. Cylinder Heater

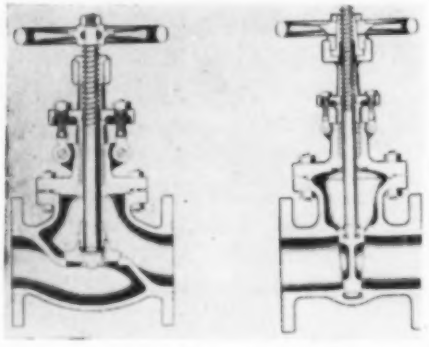
TUBULAR electrical heating elements, cast in aluminum, and espe-



cially designed for clamping to cylindrical surfaces, have been announced by Edwin L. Wiegand Co., 7514 Thomas Blvd., Pittsburgh 8, Pa. These new Chromalox units are said to provide uniform temperature, resulting from careful machining and perfect fit to the surface being heated. The use of aluminum is said to facilitate heat distribution, making possible lower operating temperatures and longer heater life. A variety of diameters to fit various cylindrical surfaces are available.

12. Corrosion Resistant Valves

A NEW LINE of alloy globe and gate valves for corrosive service, in sizes from 2½ to 6 in., has been announced by Crane Co., 836 South Michigan Ave., Chicago 5, Ill. Produced with flanged ends, these valves are available in 18-8 Mo and in Monel metal, designed for working pressures of 150 psi. liquid or gas, and working temperatures up to 350 deg. F. These valves complement the recently announced line of plug gate valves produced by this company, which are made in sizes up to 2 in. Intended especially for the handling of chemicals and other corrosive materials, the stem

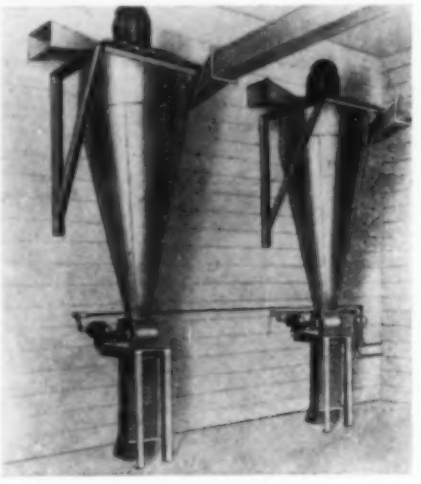


threads are outside of the valve and the stuffing box is unusually deep. The yoke and bonnet assembly is cast in one piece for greater strength and rigidity, and the bonnet is bolted to the valve body for easy disassembly.

The globe valve employs a new body design said to decrease flow resistance to a minimum. The disk has a ball-shaped seating surface giving a narrow-line bearing said to break easily through deposits left by certain types of fluids.

13. Pneumatic Conveyor

INTRODUCED for the first time at the New York Chemical Show, a new pneumatic conveying system known as the Pneu-Vac has been developed by Sprout, Waldron & Co., Muncy, Pa. The principal feature of this system is a new collector combining in one unit a centrifugal collector of cyclone type, in the upper part of which is a pneumatic fan which serves both to create a suction in the col-

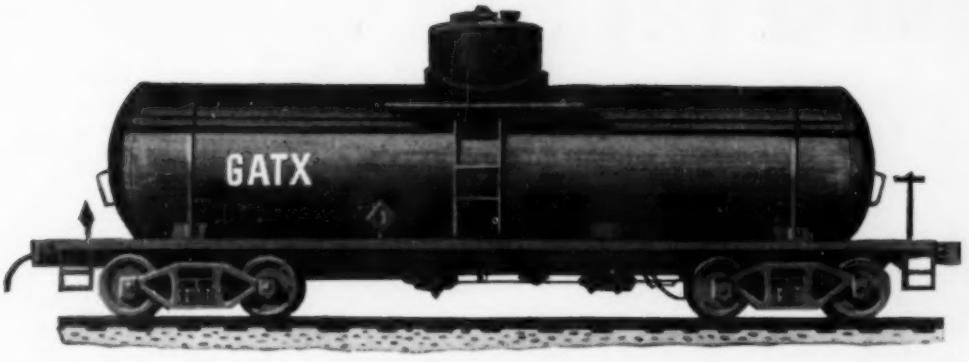


lector, and to remove fine particles from the cyclone discharge. A secondary collector is ordinarily not required. This system can be used both for pneumatic unloading of bulk materials from box cars to storage bins, and for handling the products of various kinds of grinding mills. It is claimed to operate with 25 to 50 percent less power than other pneumatic handling systems and to prevent the escape of dust from the piping system, since this part of the system is under vacuum. The material handled does not pass through the fan located at the top of the collector, so there are said to be no parts to wear out.

14. Continuous Rayon Spinning

A NOVEL DESIGN of continuous spinning machine for viscose rayon has been introduced by Dobson & Barlow Ltd., Bradley Fold, Bolton, England. Since the process is continuous from the spinnerette to the dried, twisted yarn, handling damage is said to be eliminated and greater product uniformity achieved.

As the accompanying sketch shows, the "Nelson" machine employs for each spinning position a pair of rollers 3 ft. 8 in. long and 6$\frac{5}{16}$ in. in diameter, made of ebonite and mounted so as to have a slight inclination of the axes towards each other from the wet to the dry end. The bottom roller is tilted in a horizontal as well as a vertical plane. This results in the continuous advancement of the yarn along the rollers, preventing it from piling up. A number of nozzles above the rollers provide the necessary treatments. During the first 50 convolutions around



AN IMPORTANT MESSAGE TO ALL TANK CAR SHIPPERS PLANNING EXPANSION

The demand for tank cars is so great today that many shippers are not able to meet their present transportation requirements. General American is doing everything possible to relieve this situation by producing as many cars as our supply of materials will permit.

However, we urge those of our customers who are acquiring or planning new plants to anticipate shipping requirements as many months in advance as possible. To avoid any unnecessary delay in future shipping of bulk liquids, we suggest that your traffic department check with General American on possible car availabilities well ahead of your actual needs. Consult your nearest General American district office.

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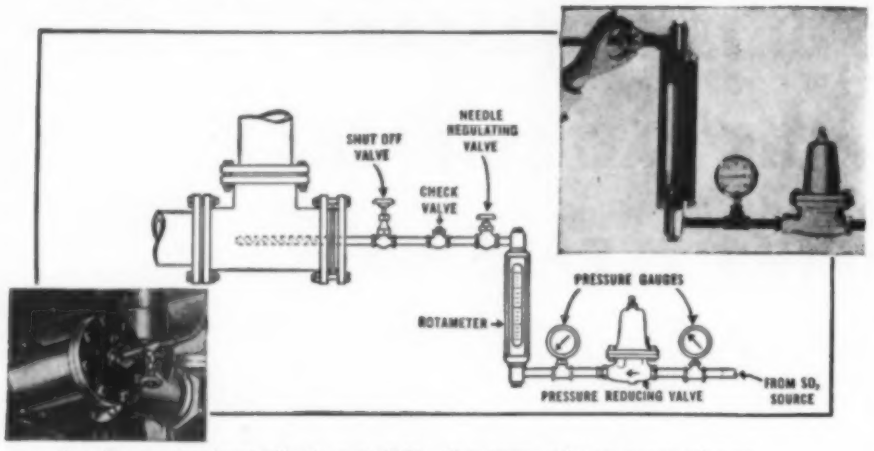
END THE SULFUR BURNING NUISANCE IN YOUR PLANT... *Economically!*

Here is How!

. . . Replace Your Burner System with

Finger-tip Controlled ANSUL SO_2



An Easy-to-Install Ansul SO_2 System gives you these Four Important Advantages

GREATER ECONOMY—Small investment in equipment, materially reduced operating and maintenance costs, and freeing of valuable floor space.

FINGER-TIP CONTROL—Easy, positive, finger-tip control providing extreme accuracy for reaction or adjustment of pH.

HIGHER PURITY—Elimination of impurities inherent in burner gases (Ansul Liquid SO_2 is 99.9+% [by weight] PURE).

GREATER SOLUBILITY—Solubility in water is 4 to 5 times greater than SO_2 from burner gas.

WRITE THE ANSUL TECHNICAL STAFF FOR FURTHER INFORMATION

LIQUID Sulfur Dioxide by ANSUL

PHYSICAL PROPERTIES

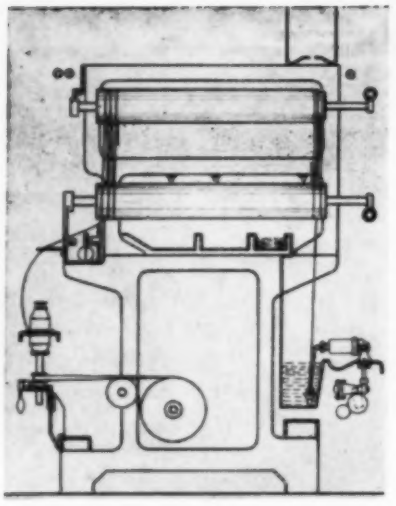
Chemical formula	SO_2
Molecular weight	64.06
Color (gas and liquid)	Colorless
Odor	Characteristic, pungent
Melting point	−103.9° F. (−75.5° C.)
Boiling point	14.0° F. (−10.0° C.)
Density of liquid at 80° F.	(85.03 lbs. per cu. ft.)
Specific gravity at 80° F.	1.363
Density of gas at 0° C. and 760 mm.	2.9267 grams per liter (0.1827 lb. per cu. ft.)
Critical temperature	314.82° F. (157.12° C.)
Critical pressure	1141.5 lbs. per sq. in. abs.
Solubility	Soluble in water
Purity	99.9+% (by wt.) SO_2 (H_2O less than 0.01%)

*REG. U. S. PAT. OFF.

Send for Bulletin 020.1, "A Comparison of Ansul SO_2 and Sulfur Burner Gas," and also for your copy of "Liquid Sulfur Dioxide"—a treatise on the properties, characteristics, and industrial uses of Liquid Sulfur Dioxide—written by the Ansul Technical Staff.

WRITE: Dept. A.

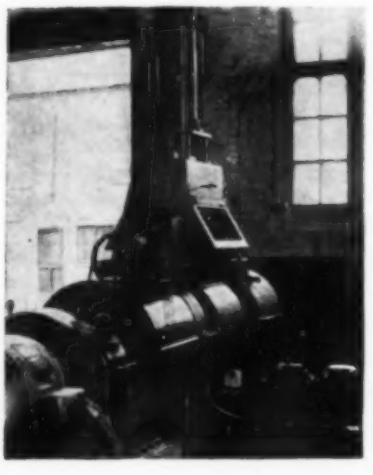
ANSUL CHEMICAL COMPANY
INDUSTRIAL CHEMICALS DIVISION, MARINETTE, WIS.
60 E. 42nd St., New York — 535 Chestnut St., Philadelphia



the rollers, coagulation becomes complete, assisted by acid provided from a jet. Excess acid drains from the lower roller and is returned to the coagulating bath circuit. Wash water is then applied after coagulation, requiring a further 30 convolutions. This water is also collected. When the thread has traveled about three-quarters of the length of the rollers it has been washed completely free from acid, and then runs into the drying section where electric heating elements dry the yarn. The drying process requires a further 30 convolutions. Finally the thread leaves the rollers over a suitable guide, is drawn over a wick oiling device and is twisted by a ring traveler on to a bobbin rotating on a vertical spindle.

15. Intensive Mixer

WORKING CAPACITIES from 1 pint to 275 gal. are available in the new Northmaster Intensive Mixer now produced by Struthers-Wells Corp., Titusville, Pa. Used for processing



natural and synthetic rubber, asphalt compositions, linoleum, paints, plastic products and other materials of similar character, the mixer is equipped with

the Zephyrweld LINE IS COMPLETE!

from 1" thru 24" O.D.

...as well as REDUCERS and ADAPTERS for use with practically all other fitting types

...A FULL RANGE OF STAINLESS STEEL WELDING FITTINGS FOR PERMANENT CORROSION-RESISTANT CONVEYING LINES

Tri-Clover now offers the most complete line of *"Zephyrweld"* stainless steel welding fittings in sizes from 1" through 24" O. D., fabricated in gauges from 16 to 10, for use with stainless steel light gauge O. D. tubing, in permanent installations where liquid conveying lines require positive protection against corrosion.

Employing modern, unique and proved methods throughout, the new *"Zephyrweld"* porosity-free fittings are fabricated from three standard stainless steel types... 304, 347 and 316.

"Zephyrweld" fitting ends are cut flush for rapid welding. Because of their light gauge, no chamfering is required. Fittings can be flame cut for disassembly, used again by re-welding. *For better, lower cost corrosion-resistant conveying lines, see your Jobber, or write for complete catalog.*

FLANGED TYPE Conical End FITTINGS ALSO AVAILABLE— *for faster installation and disassembly of lines... fabricated from stainless steel type 316 for use with commercial tolerance light gauge tubing having outside diameters from 1" thru 10". Easily assembled with lightweight, high strength couplings, which provide an extremely compact, flush, leak-tight union for working pressures up to 250 psi. Complete line of ells, tees, crosses, adapters, etc. Write for catalog.*

Tri-Clover
MACHINE CO.
Kenosha, Wisconsin

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FABRICATED STAINLESS STEEL INDUSTRIAL FITTINGS AND INDUSTRIAL PUMPS

THE Complete LINE

Stocks now carried by distributors strategically located throughout the United States

A Better Way

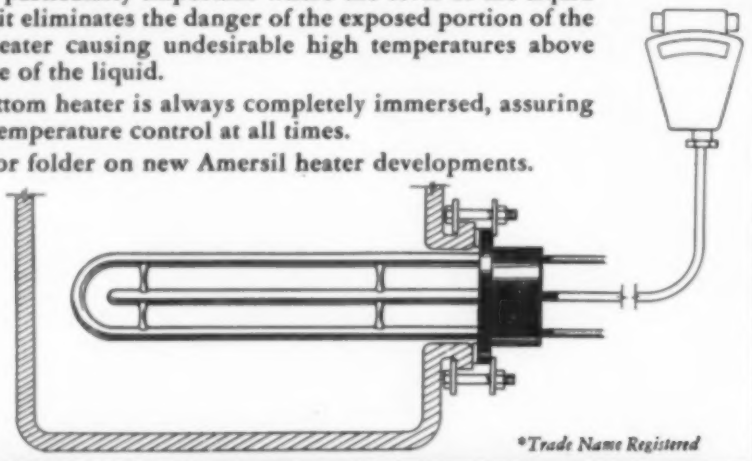
TO PROVIDE BOTTOM HEATING

BY EQUIPPING the new Amersil* opaque fused quartz electric heater with a special high temperature acid-proof resilient head, to effect a liquid-tight connection, the heating element may be located at the bottom of a vessel or tank.

This is particularly important where the level of the liquid varies, as it eliminates the danger of the exposed portion of the vertical heater causing undesirable high temperatures above the surface of the liquid.

The bottom heater is always completely immersed, assuring accurate temperature control at all times.

Write for folder on new Amersil heater developments.



*Trade Name Registered

AMERSIL COMPANY Inc.

ENGELHARD

CHESTNUT AVENUE HILLSIDE 5, N. J.

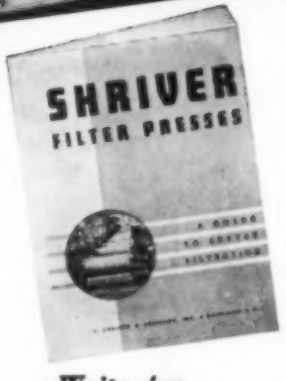
The Better Way to Filter

ANY MATERIAL at ANY PRESSURE and TEMPERATURE

The better way is with a versatile, dependable Shriver Filter Press, no matter what the material, quantity or processing requirements.

Whether you want to recover solids, clarify liquids, decolorize, deodorize, winterize, thicken, extract, wash and even partially dry the filter cake, redissolve or melt the cake, the Shriver Filter Press will do it most efficiently.

Shriver Filter Presses are made of any metal, wood, rubber, plastic or covered metal, for any capacity, to operate at any desired filtering temperature and pressure, with any filtering media or filter aids.



Write for Catalog 46.

SHRIVER FILTER PRESSES

T. SHRIVER & COMPANY, Inc.

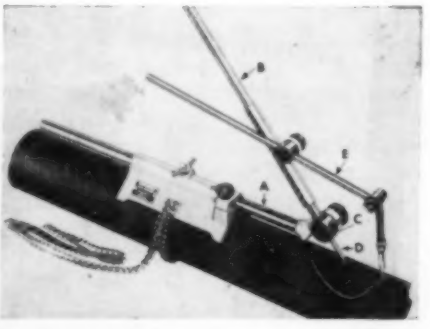
802 HAMILTON ST. HARRISON, N. J.

FOR MORE INFORMATION
See Reader Service Coupon on pages 169–170

heating or cooling jackets for the ram, trough and blades. Anti-friction bearings are employed, with a gear unit attached to the trough and rotating with it. Special metal-to-metal seals guard against leakage. 180-deg. rotation of the mixing chamber is provided to permit easy dumping and cleaning.

16. Pipe Intersection Compass

To FACILITATE the laying out of pipe intersections at various angles, prior to cutting and welding, the Martindale Electric Co., Box 617, Edgewater Branch, Cleveland 7, Ohio, has introduced a pipe intersection compass



which is rapid and easy in use. As the accompanying illustration shows, a holder A is clamped to the pipe and a stylus *D* is set at the center of the desired intersection, with leg *B* at the desired intersection angle. The compass portion *E*, which slides up and down on B, can then be swung to mark the intersection. The mark is made with a soapstone crayon.

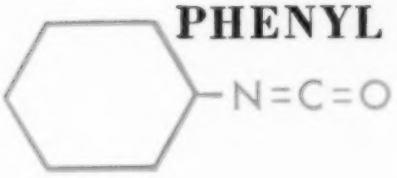
17. Hydraulic Transmission

A CAPACITY of ½ hp., continuous duty, is available in the new type TR2-R13F13 variable speed hydraulic transmission introduced by Vickers,

A NEW CHEMICAL

Hooker Research Presents . . .

PHENYL ISOCYANATE (phenyl carbonimide)



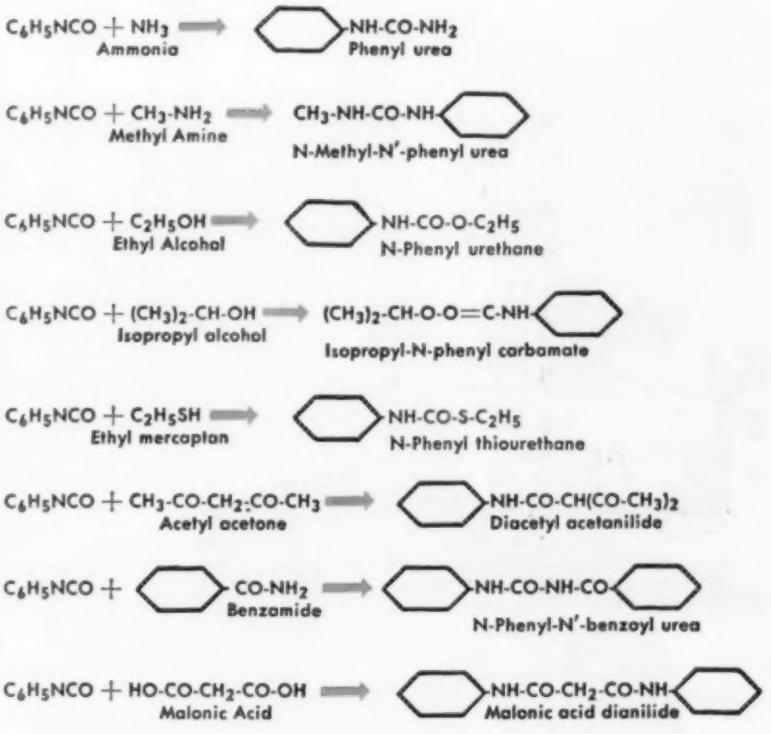
DESCRIPTION:
Phenyl Isocyanate is a pungent, lachrymatory, almost water white liquid.

PHYSICAL DATA:

Empirical Formula	C_6H_5NCO
Molecular Weight	119.12
Sp. Gravity, 15.5°/15.5°C	1.101
Refractive Index, n 20/D	1.535
Freezing Point	−33°C
Boiling Point	162°C
Vapor Pressure, 100°C	108 mm
Flash point (closed cup)	63°C

SUGGESTED USES:
As a versatile intermediate for chemical synthesis, it has many interesting possibilities in the manufacture of alkyd resins, textile finishing agents, herbicides and other as yet undiscovered products. Among the various classes of compounds that might be produced thru phenyl isocyanate are: other isocyanates, ureas, anilides, dianilides, urethanes, thiourethanes, carbamates, and thiocarbamates.

SOME TYPICAL REACTIONS *of Phenyl Isocyanate*



For more technical information, write on your company letterhead for Data Sheet No. 372. Limited sample quantities of this product are available for experimental work.

HOOKER ELECTROCHEMICAL COMPANY

5 Forty-Seventh St., Niagara Falls, N. Y.
New York, N. Y. Wilmington, Calif. Tacoma, Wash.

HOOKER CHEMICALS

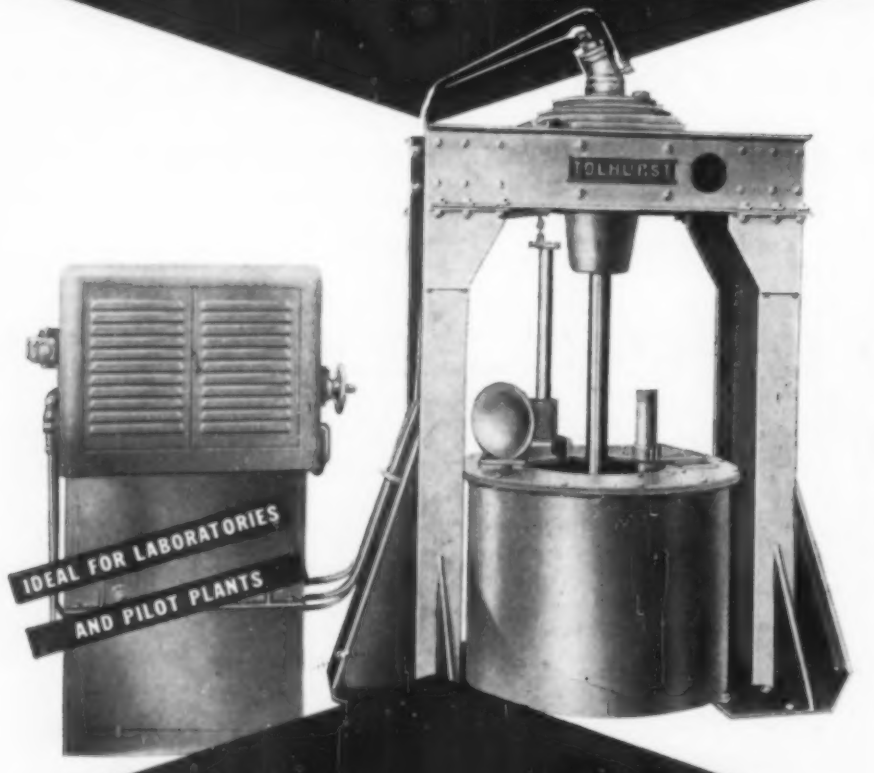
Caustic Soda Muriatic Acid Sodium Sulfide Paradichlorbenzene Chlorine Sodium Sulfhydrate

HIT OF THE SHOW! DID YOU SEE IT?

NEW

TOLHURST

variable speed
pilot plant centrifugal
with hydraulic drive



ONLY MACHINE of its type with variable speed hydraulic drive. Smooth, stepless speed variation from 0 to 2150 RPM. Centrifugal force range up to 1700 times gravity.

BASKETS 20" and 26" in diameter. Perforate and imperforate types available. Interchangeability of baskets made easy by drop-bottom case.

ADDITIONAL FEATURES include counterbalanced unloader and tachometer to indicate basket speed. Single speed, horizontal type motor, open, totally enclosed fan cooled or explosion-proof as specified.

LABORATORY SERVICE AVAILABLE—For confidential, unbiased and intelligent recommendations on your centrifugal problems, consult Tolhurst with its well-qualified staff and modern research facilities.

FOR SPEED AND CONVENIENCE IN

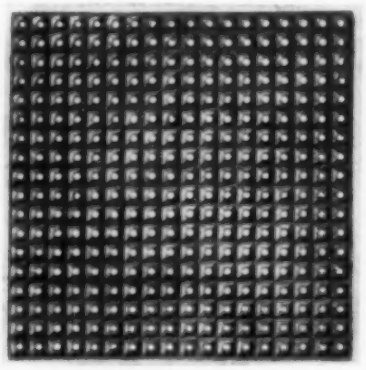
★ FILTERING
★ DRAINING SOLIDS
★ DEHYDRATING SOLIDS
★ CLARIFYING LIQUIDS
★ THICKENING SUSPENSIONS
★ SEPARATING LIQUID MIXTURES
★ SEPARATING SOLIDS SUSPENDED IN LIQUIDS

TOLHURST CENTRIFUGALS
Division of American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS
In Canada: American Machine and Metals (Canada) Ltd., 215 St. James St. W., Montreal 1, P.Q.

Inc., 1576 Oakman Blvd., Detroit 32, Mich. This device, suitable for driving fractional horsepower machinery, features stepless speed adjustment from zero to a maximum on the output side, in either direction of rotation. Full and constant torque power characteristics are maintained throughout the entire speed range. The input shaft may be driven in either direction without mechanical change. The unit may be stalled without damage as it is equipped with an automatic overload protection device. Adjustment may be made either by a handwheel or by a servo control.

18. Backing Plate

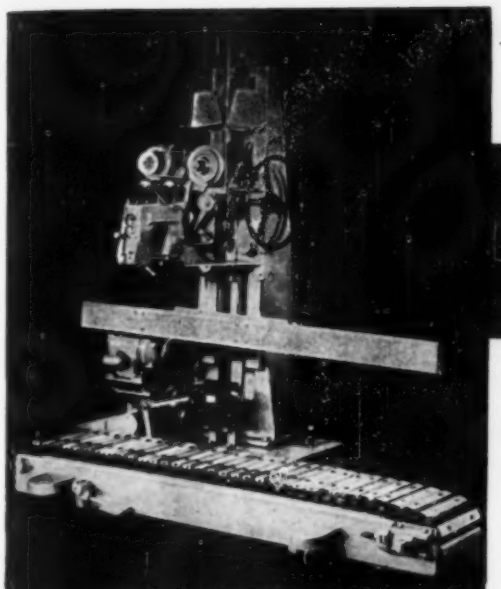
As a backing for use with filter screens of all types, such as fine perforated plate, woven wires, silk cloth, filter media, etc., the Pyramid Industrial Screen Co., 1121 East 37th St., Brooklyn, N. Y., has introduced a cast



backing plate with pyramidal holes said to offer a maximum of open area back of the screen. Filtration begins at the base of the pyramid-like depressions, instead of the perforations of a standard backing plate. In some cases double the open area is said to be available for filtration, with consequent doubled capacity. Furthermore, the tapering of the pyramid openings is said greatly to decrease blinding from sticky materials. It is possible to make these plates extra thick for resistance to high pressures, or to secure long life under abrasive conditions. These plates are recommended by the manufacturer for use in centrifugals, filter presses, vacuum and pressure filters, and all other installations using a combination of backing plate and filter medium.

19. Improved Hose Valve

Tight closing, with extremely light opening pressure, is claimed for a new venturi-type automatic hose valve introduced by Paul Valve Corp., 157 East 128th St., New York 35, N. Y. The valve is a straight-through type, its bore consisting of a venturi



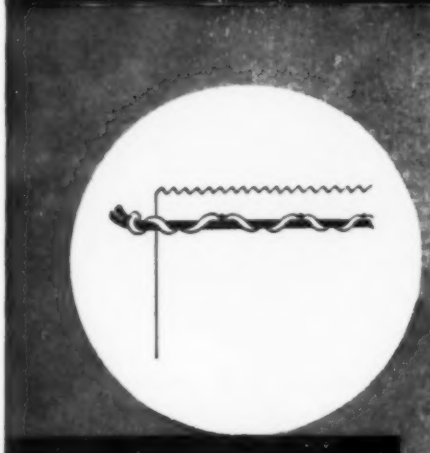
MODEL "E 1" (portable)—one operator can close up to 15 filled bags per minute. A single foot pedal controls both conveyor and sewing head. Handles both paper and textile bags.

Strong, Tough Closures

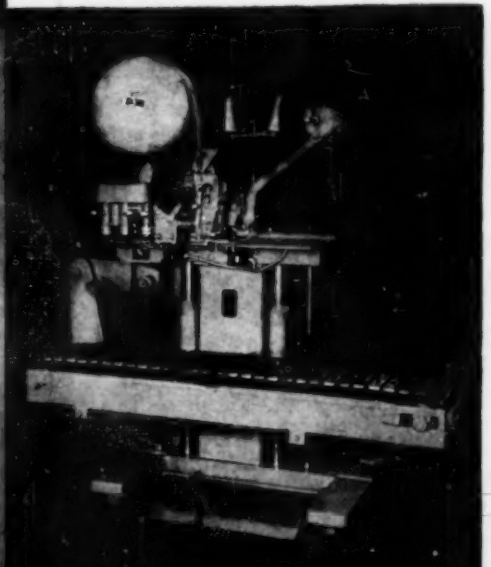
—mass produced!

Mechanize your closing of heavy-duty, multiwall paper bags, with BAGPAKERS.® You swing into production line speed—up to 15 bags per minute. BAGPAKERS apply famous "cushion-stitch" closure that absorbs strains and won't pull out. When sealed with strong BAGPAKER tape, the "cushion-stitch" closure is moisture-resistant, contamination-proof and *sift-proof.*

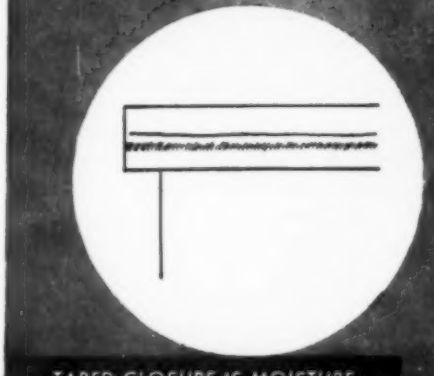
Talk over your closing and handling methods . . . your multiwall paper bag requirements, with a BAGPAK engineer. He knows ways to speed operations and cut costs.



ALL BAGPAKERS MAKE THIS FAMOUS "CUSHION-STITCH"



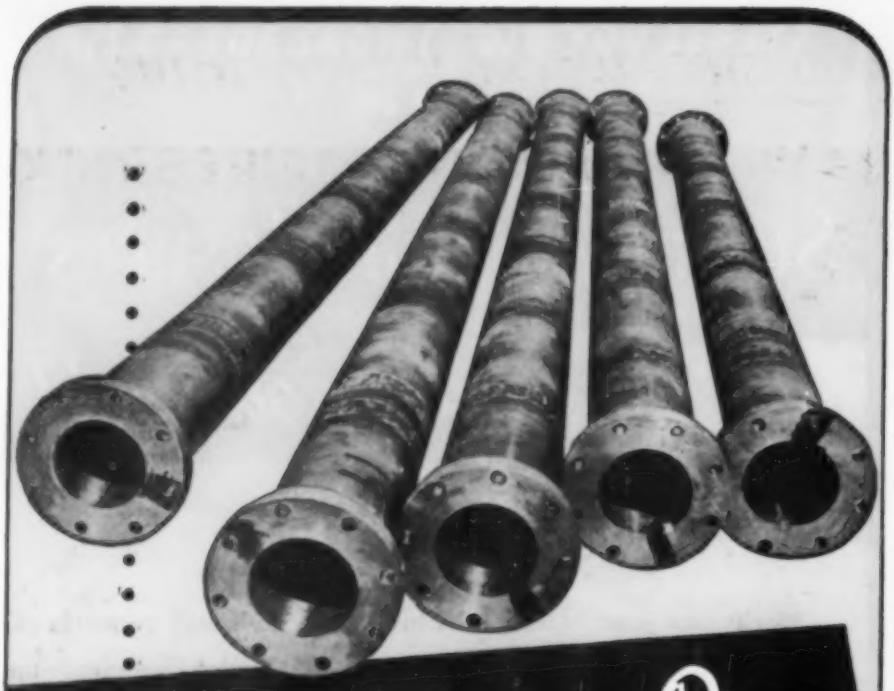
MODEL "DA" (portable) applies taped "cushion-stitch" closure. One operator, filling and closing, can handle 2 to 4 bags a minute . . . 6 to 12 where filled bags are delivered to BAGPAKER conveyor. Sewing operation starts and stops automatically—no tape wasted.



TAPED CLOSURE IS MOISTURE RESISTANT—SIFT PROOF—TOUGH
Taped closure is effected on Model "DA"

BAGPAK DIVISION

INTERNATIONAL PAPER COMPANY, Bagpak Division • 220 East 42nd Street, New York 17
BRANCH OFFICES: Atlanta, Baltimore, Boston, Chicago, Cleveland, Joplin, Mo., Los Angeles, New Orleans, Philadelphia, Pittsburgh, St. Louis, Syracuse. **IN CANADA:** Continental Paper Products, Ltd., Montreal, Ottawa.



Beer won't rust your Pipes

...when they are made from acid- and corrosion-resistant Ampco Bronze and welded with Ampco-Trode 10 aluminum-bronze electrodes

Here's another process application for Ampco — this time in a brewery, one of the largest in the country. These pipes, made from grade 40 Ampcoloy, an engineered aluminum-bronze alloy, are 14 feet 7⅝ inches long and 8 inches in diameter. Eight separate pieces centrifugally cast form a complete pipe. These pieces with 11-inch end flanges are welded together with Ampco-Trode 10 aluminum-bronze electrodes. Ampco-Trode 10 was used because it has the same acid- and corrosion-resistant and physical properties as the parent metal.

This pipe is used because it does not produce cloudiness in the beer. It saves money for the brewery because it lasts indefinitely and does not affect the flavor.

Other process industries throughout the country are using large quantities of Ampco aluminum bronzes, too. They find that Ampco bronzes have many desirable service qualities not found in other anti-acid metals. High tensile strength. Good ductility. Less weight. Favorable hardness. This popular aluminum-bronze alloy resists corrosion, erosion, cavitation — it handles successfully such liquids as acids, alkaline solutions, sea water, mine waters, petroleum sludge, hot brine, and food-product liquors.

Save yourself money, trouble, and time — send your processing problems to us. Our engineers can help you adapt assemblies fabricated out of Ampco Metal to your requirements. Write for our latest descriptive bulletins.

AMPCO TRADE MARK REG. U. S. PAT. OFF.

Ampco-Trode 10 is a product of

Ampco Metal, Inc.

Department CE-1 Milwaukee 4, Wis.

P-20

FOR MORE INFORMATION
See Reader Service
Coupon on pages 169–170

section interrupted at the throat by a slot crossing the throat. In this slot is a hardened Monel metal ball which, through the action of the jet, automatically seats against the downstream entrance of the venturi. A plunger operated by a thumb button easily displaces the ball from its seat and pushes it to one side to permit flow. Releasing the button causes the ball immediately to reseat itself.

20. Pneumatic Transmitter

IDENTIFIED as Model 42, a new pneumatic transmitter has been announced by the Foxboro Co., Foxboro, Mass. The device may be used for remote transmission of process

measurements such as flow, static or differential pressure, liquid level, temperature or humidity. It is essentially an improved design of this company's earlier transmitter, but is provided with important improvements. It incorporates a completely new transmitting element which is exactly duplicated in the receiving instrument, and said to give improved accuracy. Simplified calibration is another advantage.

21. Equipment Briefs

TO PERMIT return of condensate to boilers at even higher pressures than formerly Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia 32, Pa., has announced development of a new CBA high-differential condensate return system. The new system permits the return of condensate either to higher pressure boilers, or return of lower pressure condensate to boilers of the same pressure range as formerly.

22. A LINE of permanent-magnetic pulleys with Alnico poles is now being offered by Dings Magnetic Separator Co., Milwaukee, Wis., in 53 sizes

And you save on steel-work, too, by using

LIGHTWEIGHT B&W INSULATING FIREBRICK

Saving steel reduces first cost, lets you stretch your available supply. Furnace designers and builders are making substantial savings in supporting steel-work and foundations by lining process furnaces with B&W Insulating Firebrick—*for B&W IFB weigh considerably less than ordinary firebrick. They are the lightest of all insulating firebrick.*

Light weight B&W IFB are the key to other important cost-savings too. Because of their low heat storage capacity and high insulating value, they enable furnaces to respond more readily to temperature changes, affording better quality control. Heating-up and cooling-off periods are shortened. Fuel consumption is reduced, and there is far less refractory maintenance and much greater furnace availability.

Your local B&W Refractories Engineer will be glad to show you how B&W Refractories products may contribute to lower first cost and greater overall production efficiency in *your* furnaces.

R-309A

B&W REFRACTORIES PRODUCTS

B&W 80 FIREBRICK • B&W JUNIOR FIREBRICK
B&W 80 GLASS TANK BLOCKS • B&W INSULATING FIREBRICK
B&W REFRACTORY CASTABLES, PLASTICS AND MORTARS

•

OTHER B&W PRODUCTS

Stationary & Marine Boilers and Component Equipment
Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers
Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 85 LIBERTY ST., NEW YORK 6, N.Y.
WORKS: AUGUSTA, GA.

NO MORE CORROSION DAMAGE...

ATLAS ACID- AND ALKALI-PROOF CONSTRUCTION PUTS AN END TO IT...ALONG WITH RESULTING "DOWN TIME" AND LOSS TO PRODUCTION . . .

Atlas-designed Saturator. Handles solvents and sulphuric acid up to 150° F.

Electrolytic tanks used for 20% H_2SO_4 at 180° F. and 20% $CuSO_4$ also at 180° F.—87 tanks in group, each 7' x 4' x 9' deep. Lined with Atlastseal and brick, joined with Atlas KOREZ (acid-proof cement).

Regardless of the type of acids or alkalis you use, you can now have equipment of Atlas material and design, completely proof against — not merely *resistant* to specified acids, organic and inorganic, alkalis, solvents, oils and greases, water, steam and high temperatures.

Such equipment, for which the largest chemical and steel producers look to Atlas, includes floors, tanks, stacks, towers, fume ducts, trenches, neutralizers, etc. These units are built of acid- and alkali-proof materials, which include cements, plastic linings, jointing materials and protective coatings.

Atlas offers a complete service and is prepared to see the job through from plan to finished construction, if desired. Our engineers will make recommendations and submit plans and estimates—without obligation. Contact our nearest branch—and write us at Mertztown for Bulletin TB-1.

THE *Atlas Mineral*

PRODUCTS COMPANY OF PENNA.

MERTZTOWN PENNSYLVANIA

*ATLANTA 3, Ga., 452 Spring St., N. W.
*CHICAGO 1, Ill., 333 No. Michigan Ave.
*DETROIT 2, Mich., 2970 W. Grand Blvd.
NEW YORK 16, N. Y., 280 Madison Ave.
PITTSBURGH 27, Pa., 4921 Plymouth Rd.
PHILADELPHIA, Pa., 355 Fairview Rd. Springfield, Pa.
ST. LOUIS 8, Mo., 4485 Olive St.

THE ATLAS MINERAL PRODUCTS CO. OF TEXAS, INC. Box 252, Houston 1, Texas

DALLAS 5, Tex., 3921 Purdue St.
*DENVER 2, Colo., 1921 Blake St.
*HONOLULU 2, Hawaii, U.S.A., P.O. Box 2930
OMAHA, Neb., 423 South 38th Ave.
*KANSAS CITY 2, Kan., 1913 Tauromee Ave.
*LOS ANGELES 12, Cal., 172 S. Central Ave.
NEW ORLEANS 12, La., 208 Vincent Bldg.
*SAN FRANCISCO 3, Calif., 244 Ninth St.
*SEATTLE 4, Wash., 1232 First Avenue, S.
*Stock carried at these points

IN CANADA: Atlas Products are manufactured by H. L. BLACHFORD, Limited, 977 Aqueduct Street, Montreal, P. Q., 86 Bloor St. W., Toronto, Ont.

ranging from 12 in. diameter by 12 in. width, to 30 in. diameter by 60 in.

23. ONLY 15 in. long by 1¾ in. in diameter, a new small carbon dioxide fire extinguisher for placement alongside hazardous spots is being offered under the name of Power-Pak, by Power-Pak Products, Inc., 43 Pearl St., Buffalo 2, N. Y. The unit weighs only 2 lb. 6 oz., and contains 10 oz. of carbon dioxide gas.

24. AVAILABILITY of nylon filter cloth has been announced by Filter Media Corp., Hamden 14, Conn. This cloth is said to be substantially inert to most common alkalis, most organic acids, halogenated hydrocarbons, aldehydes, ketones, alcohols, carbon bisulphide, carbon tetrachloride, trichlorethylene, and benzene. Twill, chain and plain weaves in numerous porosities and widths are available. Made-up filter elements can also be provided.

25. A NEW USE for its well-known countercurrent classifier has been announced by Hardinge Co., York, Pa. This machine, which is a rotating cylinder containing a continuous spiral baffle, can be used in thorough washing of the cullet or broken glass which is one of the ingredients used by the glass industry in the manufacture of new glass. It is said that no completely satisfactory method of washing cullet has heretofore been available.

26. A COMPLETE line of permanently magnetized magnetic separators, including magnetic pulleys, drums, spout and suspended magnets, as well as other types of standard and special designs, is now available from Magnetic Engineering & Mfg. Co., Clifton, N. J. This line supplements the company's wide variety of electromagnetic separators for all purposes.

27. SPECIAL strapping for insulation binding and other maintenance and operational functions in chemical plants is now available from A. J. Gerrard & Co., Chicago, Ill. Among other special strapping materials are stainless steel, copperclad, Monel and galvanized.

28. To IMPROVE the wetting properties of water as a fire extinguishing agent, American-La France-Foamite Corp., Elmira, N. Y., has announced Pentrate, a wetting agent which is used to the extent of 1 percent in water for certain fire-fighting applications. It is said to be particularly effective in fighting deep-seated smoldering fires, such as fires in bales of cotton, waste and similar materials, as well as coal piles.

NEW PRODUCTS AND MATERIALS

Richard W. Porter, ASSISTANT EDITOR

CONTENTS

Rosin Derived Alcohol	173
Viscous Plasticizer	173
Colloidal Silica	173
Seed Disinfectant	174
Peracetic Acid	174
Hydroquinone Derivatives	176
Insecticides	178
Woodworking Adhesives	178
Surgical Aid	180
Redwood Bark Derivative	180
Piezoelectric Crystals	182
Penicillin Aid	182

FOR MORE INFORMATION
See Reader Service
Coupon on pages 169–170

51. Rosin Derived Alcohol

AVAILABLE for the first time in commercial quantities, a new low-cost resin alcohol made from rosin is being manufactured at the Burlington, N. J., plant of the Hercules Powder Co., Wilmington, Del. Having potential application in a variety of industries, hydroabietyl alcohol is the first primary alcohol to be developed from rosin on a commercial scale. In comparison to all other rosin derivatives, this new alcohol is the most resistant to discoloration and degradation by light or air.

Hydroabietyl alcohol is a viscous liquid at room temperature, is colorless, tacky, and, in contrast to common alcohols, it is not miscible with water. Its resinous nature, together with the similarity of its properties to those of other high molecular weight alcohols, suggests a variety of industrial applications where low cost is an important factor. Hydroabietyl alcohol is miscible with other alcohols, ketones, esters, ethers, hydrocarbons and chlorinated hydrocarbons, and is compatible with many film-formers and resins used in protective coatings, adhesives, and other similar products. It can be used without further chemical reaction as a modifier for chlorinated rubber, polyamides, hydrogenated oils, textile sizes, rubber compositions, and essential oil vehicles.

While the published research has disclosed a variety of valuable products that may be derived from this alcohol including resins, foamers, detergents, wetting agents, emulsifying agents, plasticizers, corrosion inhibitors, anti-oxidants, parasiticides, and other similar compounds, a more thorough investigation of the industrial usefulness has awaited the commercial availability of this resinous alcohol.

52. Viscous Plasticizer

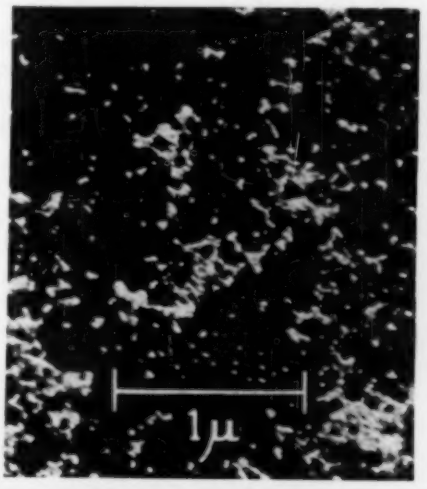
ANOTHER petroleum derived plasticizer has been announced by the Standard Oil Co. of New Jersey, 15 West 51st St., New York 19, N. Y. Having high viscosity and good compatibility with resins, this new product, resulting from a solvent extraction process, has been tested in a wide variety of applications. Known as NUSO 250, this plasticizer has the following physical characteristics: API gravity, 11.5; specific gravity, 0.989; lb. per gal., 8.24; flash point, deg. F., 470; Saybolt Universal viscosity at 100 deg. F., 45,000; Saybolt Universal viscosity at 210 deg. F., 254; color, dark-clear; pour point, deg. F., +50, aniline point, deg. F. (ASTM D-611), 120.

One notable characteristic is the extreme change in viscosity between the temperatures of 100 deg. F. and 210 deg. F. While this characteristic would be objectionable in the field of lubrication, it is desirable in applications of plasticizers. The viscosity characteristics of NUSO 250 prevent migration within the composition after it is prepared. This means that the consistency will remain the same throughout the finished product, thus minimizing the tendency to become brittle and to crack. High viscosity at ordinary temperatures provides a greater weight percent of the plasticizer to be used in a given composition.

Suggested applications for NUSO 250 are in the manufacture of floor tile, caulking and potting compounds, printing inks, rubber compounding, wax compositions, rust preventives, waterproofed canvas, paper laminates, etc. Many of these suggested applications were developed during the field testing of this new product.

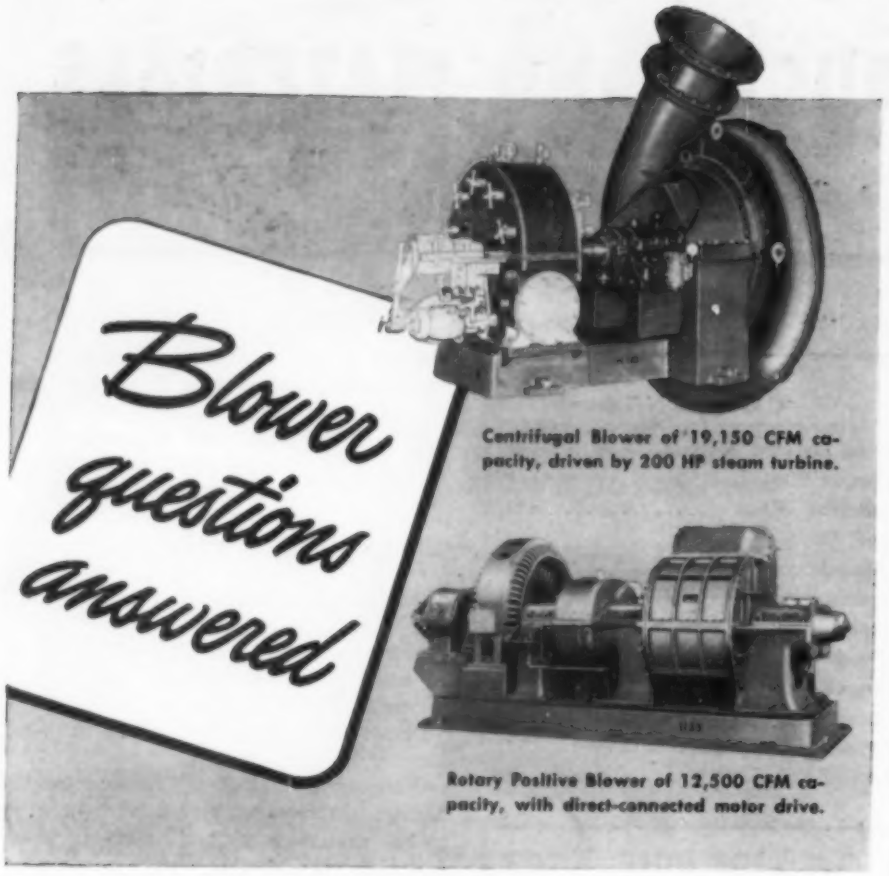
53. Colloidal Silica

COLLOIDAL silica, under the name of Ludox, is now manufactured by a new patented process by the E. I. du Pont de Nemours & Co., Wilmington 98, Del. Ludox is a salt and sodium-free sol made by reacting sodium silicate with an acid form of a cation exchange resin. It consists of a faintly opalescent water solution containing SiO_2 in a relatively high state of purity and in a highly divided chemically reactive form. Solutions of 18 percent silica concentration are already available, and it is expected that a 30 percent solution will be ready for the market early in 1948. These solutions can be stored for indefinite periods without any trace of settling or gelation. However, they can be readily precipitated or gelled by the addition of certain salts or organic materials.



Individual particle size of colloidal silica is indicated

Studies have shown Ludox to have individual particle size of less than


Blower questions answered
Centrifugal Blower of 19,150 CFM capacity, driven by 200 HP steam turbine.
Rotary Positive Blower of 12,500 CFM capacity, with direct-connected motor drive.

by R-C dual-ability

When you put your blower questions up to Roots-Connersville, you gain these important advantages:

1. Long experience in the adaptation of blowers to needs of the chemical industry, coupled with the forward-thinking of our alert engineers.
2. Our *dual-ability* to supply either Rotary Positive or Centrifugal Blowers, whichever type is best fitted to the specific work.
3. A wide range of standard capacities, from 5 CFM to 50,000 CFM (or higher), adapted to any modern drive, which makes for lower prices and faster deliveries than "special" designs.

Finally, when you have selected the R-C Blower that satisfies your requirements, you can be certain of sound, sturdy construction, low maintenance and operating costs, and a long life of profitable performance. For accurate answers to your blower questions, consult us.

In 1858, when the Atlantic Cable carried its first message, "Roots" had been building blowers for four years, since 1854. We're not good because we're old, but old because we're good.

ROOTS-CONNERSVILLE BLOWER CORPORATION
801 Illinois Ave., Connersville, Ind.

ROOTS-CONNERSVILLE ROTARY CENTRIFUGAL
BLOWER BUILDERS R-C SINCE 1854
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one millionth of an inch in diameter, and that it is highly hydrated. In this respect it resembles organic colloidal materials rather than the hitherto available finely divided suspended inorganic powders. It is believed that this hydration, along with fine particle size and low molecular weight, is responsible for the reactivity of this new form of colloidal silica. This material can be used to modify other substances to utilize the properties of silica, such as mechanical strength, resistance to atmospheric and chemical agents, and resistance to heat.

One example of such reactions is that Ludox has an insolubilizing action on water soluble substances, such as starch, proteins, and water soluble synthetic resins. Thus, it is expected to find application in the surface treatment of paper, organic textile finishing treatments, leather dressings, and other similar processes.

This product also appears to combine with water insoluble substances, such as Neoprene and rubber wherein it exerts a reinforcing action similar to the action of carbon black. It is suggested, then, that Ludox may be used where a colorless reinforcing agent for rubber is desired. Ludox is now available in small commercial quantities, but the manufacturer plans to make it available in increasing amounts.

54. Seed Disinfectant

Now recommended to combat numerous seed-borne and soil-borne crop diseases is a new seed disinfectant available from the E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del. Known as Ceresan M, this disinfectant contains, as an active ingredient, ethyl mercury p-toluene sulfonanilide. One important characteristic of this new material is that, when properly handled, it greatly reduces the hazard of irritation of the skin of persons using it. It is a dry powder and can be used in any equipment that insures complete coverage of seed, such as in mechanical treaters and home-made rotary drums.

55. Peracetic Acid

ACTIVE OXYGEN makes up 8.6 percent of a stable 40 percent solution of peracetic acid now being manufactured by the Buffalo Electro-Chemical Co., Inc., Buffalo, N. Y. Large scale production by this company of hydrogen peroxide at 90 percent concentration has made it possible for them to develop a commercially useful process for the manufacture of peractetic acid. Solutions of the acid are efficient bleaching agents for various textiles, for pro-

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APPEARANCE: Clear, colorless liquid; Low acid, ash, and metal content.

Formaldehyde *Heyden* is rigorously controlled to assure consistent yields and high quality of finished products. Technical data on the use and handling of formaldehyde are available upon your request.

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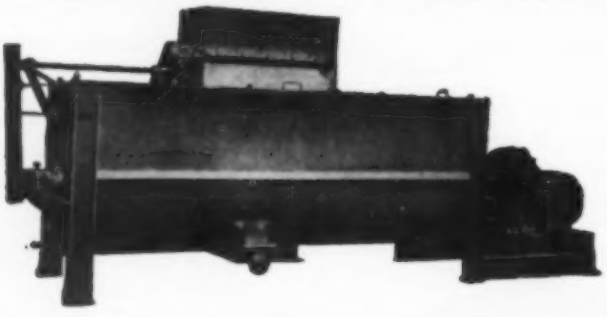

Capacities from 1 to 234 cu. ft. per charge. Agitator design relieves end-load strain on outboard roller bearings. Inlet and discharge gates centrally located. Flush-fitted or sealed covers. Packing glands conveniently situated on Mixer body. Designed by experienced engineers and built to specifications. Robinson Equipment is available for all processing requirements . . . mixing, grinding, sifting, crushing, blending, etc. Inquiries invited!

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FOR MORE INFORMATION
See Reader Service Coupon on pages 169–170

teins and generally for alkali sensitive materials. They are effective in acid and neutral as well as in alkaline solution. Bulk and emulsion polymerizations can be carried out using peracetic acid as polymerization catalyst. Bacteria and other micro-organisms are killed rapidly by contact with a very dilute solution. Enzyme systems are inactivated by it. In the food processing industries this characteristic may be used to prevent browning of cut fruits and vegetables. Organic syntheses such as hydroxylation or epoxidation of olefinic double bonds are possible because of peracetic acid. Substituted benzene or naphthalene rings undergo splitting by reacting with this oxidizing agent. Peracetic acid is available in limited quantities.

56. Hydroquinone Derivatives

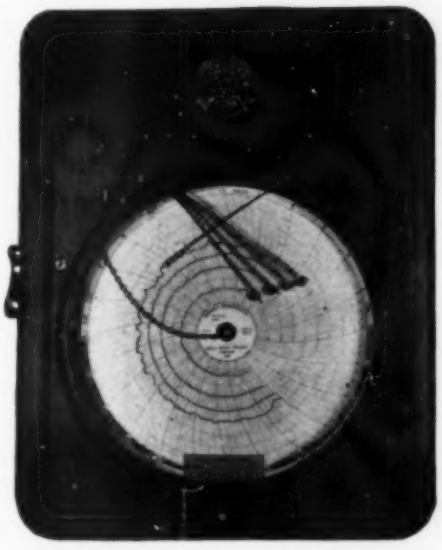
Low oil solubility and high water solubility restrict the use of hydroquinone as an antioxidant and stabilizing agent for preventing deterioration of fats, oils and resin monomers. Tennessee Eastman Corp., Kingsport, Tenn., is now making, in commercial quantities, two derivatives of hydroquinone which overcome this difficulty. Both hydroquinone mono methyl ether and 2,5-ditertiary butyl hydroquinone show little tendency to discolor.

Hydroquinone mono ethyl ether is finding application as a stabilizing agent in textile lubricating-oil formulas. Because of the stability of the ether groups, this compound is also a promising raw material for organic syntheses, and is said to have possibilities in the fields of drugs, cosmetics and dyes. In both synthetic and natural rubber compositions, 2,5-ditertiary butyl hydroquinone has been found suitable as a preservative. It is a good polymerization inhibitor for styrene and other resin monomers. Non staining and non discoloring, it is particularly useful for stabilizing latices and white stock such as are employed in many mechanical rubber fabrications.

Another derivative hydroquinone dimethyl ether is stable and is unaffected by boiling acids or alkalies. Since the ring hydrogens are labile, it has many possibilities in organic syntheses. This chemical has a very pleasing fragrance of sweet clover. For this reason, it is finding acceptance in the perfume in-

Take 4
Add 8
Get 100,000

Trick Arithmetic?



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NOT AT ALL. It's an equation instrument users are applying to simplify meter and control installations. It's an equation worth remembering.

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The Bailey Meter Company has simplified electronic instruments and controls to 4 basic circuits and 8 basic component parts. With these 4 circuits and 8 parts you can get more than 100,000 combinations of electronic instruments and controls.

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Tube problems vanish, too, when Bailey Meters are installed. Tubes are the standard, easy-to-get type. Specials and order-from-the-factory variety have been avoided.

If you are crowded for panel space, then by all means get complete information about Bailey Meters and Controls. Write today for a copy of bulletin No. 17. Bailey Meters save panel space.

P-14

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4 records, 1 chart

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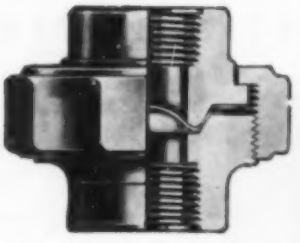
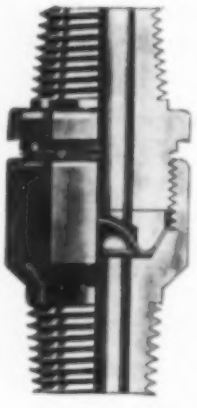
Wherever pressure is employed, you'll find a need for Black, Sivalls & Bryson SAFETY HEADS. A wide variety of sizes and types are available, engineered for each problem, based upon the particular needs of the job. All employ the famous B S & B metal diaphragm that breaks in tension at pre-determined pressure and temperature. No other pressure relief device offers such complete protection with such economy . . . none can approach the relief capacity of a SAFETY HEAD in a given diameter. SAFETY HEADS are built for a specific job . . . pressure relief. No pressure vessel equipped with a SAFETY HEAD has ever burst from over-pressure.



Versatile . . . Simple . . . Sure!



Pressures up to 25,000 psi, liquids or gases . . . SAFETY HEADS handle them in perfect safety. Act instantly. Provide full-pipe size unrestricted relief opening. No working parts. Quickly installed, easily replaced. Tamper-proof. New SAFETY HEAD rupture discs are guaranteed to burst within five percent of specified pressure at stated temperatures

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KANSAS CITY, MO. — OKLAHOMA CITY, OKLA.

dustry, particularly in the formulation of soap perfumes. It is also useful as a weathering agent for paints and plastics and in sun-tan lotions and creams. Further processing of hydroquinone dimethyl ether lends to amino hydroquinone dimethyl ether, an intermediate in the manufacture of certain naphthol dyes. Other hydroquinone derivatives made by this company include toluhydroquinone, hydroquinone diethyl ether, hydroquinone di-n-butyl ether, hydroquinone mono ethyl ether, hydroquinone mono-n-butyl ether and hydroquinone di (beta hydroxyethyl) ether.

57. Insecticides

UNCOVERED by scientific teams in Germany at the close of the war was a new chemical compound that has turned out to be an effective insecticide against a wide range of insects. The Germans tested it briefly, but did not develop a method for commercial production. A commercial method for making this compound has been developed by the Agricultural Chemical Div., American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y. Having the brand name of Thiophos 3422, this new insecticide with the chemical name of o,o-diethyl o-p-nitrophenyl thiophosphate. The compound in technical grades is a liquid. After formulation into wettable powder, it can be used as a spray. It can also be formulated for use as a dust.

Thiophos 3422 was widely tested during 1947 and is claimed to be effective against a wider range of insects, mice, and other similar bugs, than other chemical compositions now in practical use. This includes nicotine, rotenone, DDT, and other compounds. Commercial quantities of this new insecticide will be manufactured in 1948 and will be available through regular distribution channels.

58. Woodworking Adhesives

BOWLING PINS, according to the Midland Glue Products Co., 1478-88 Madison Ave., Detroit, Mich., have been laminated with its new Wood-Tite glue and have thereafter withstood over 3,000 games. Ready for use as delivered, this cold liquid adhesive requires clamps or pressure for a short time to permit it to set. For bonding of all types of wood and plywood its features include resistance to extreme heat, cold and moisture, freedom from obnoxious odors and stability in storage. It dries transparent and may be easily sanded. Wood-Tite glue has found use in cabinet making, maintenance and repair shops,

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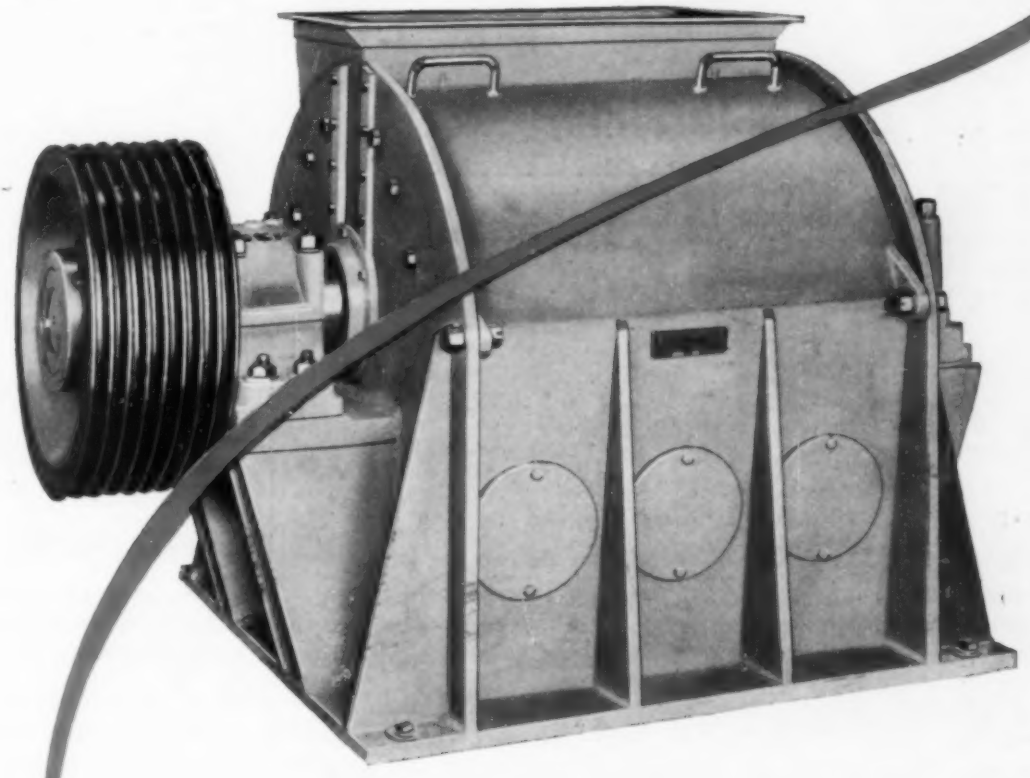
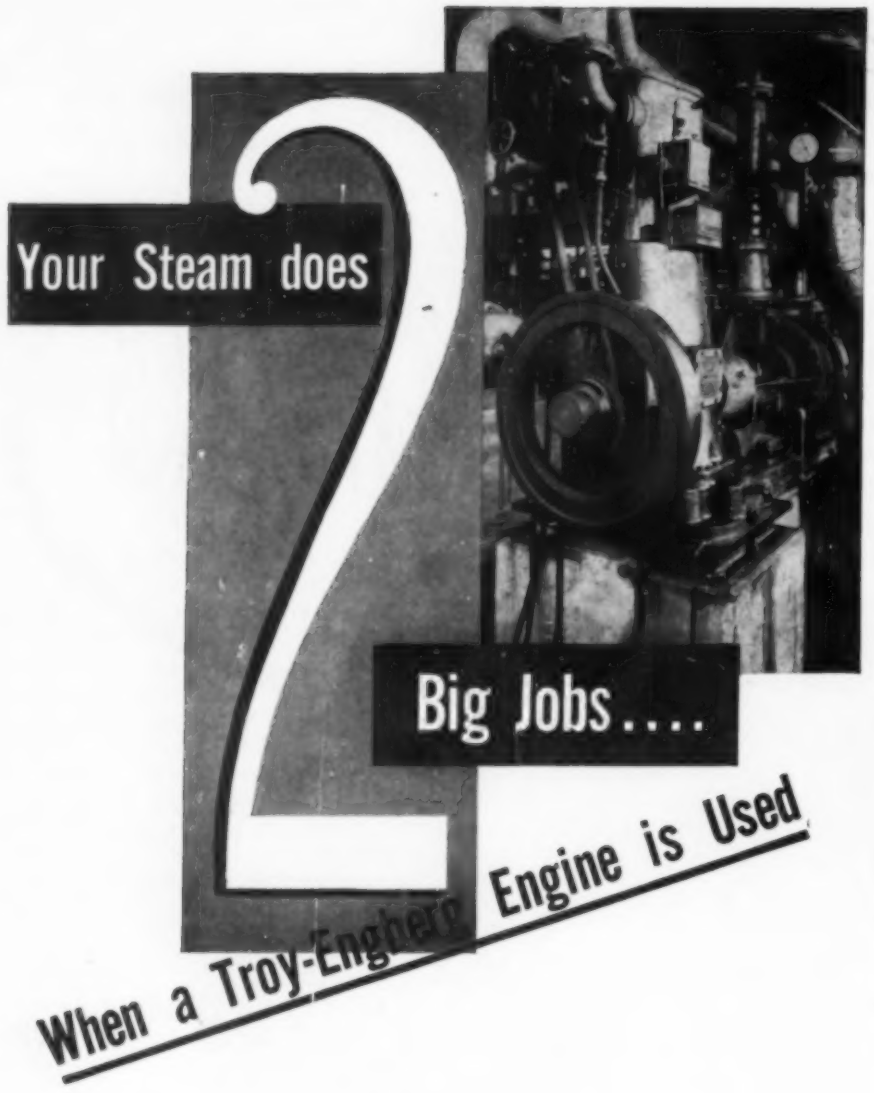
Wherever leaf processing is on a production basis . . . or wherever interlaced fibrous materials must be torn apart . . . consider this machine. Its special purpose design, its intermeshing, serrated knives may mean new and unexpected profits to your industry too.

In the tobacco industry, stripping the leaf from the stem was considered for years a time-consuming, hand operation. But no longer! Today, leaf processors count on the Sprout-Waldron unit shown below to do the job better and faster. The machine's sturdy thresher-action speeds production with a minimum of fines at tremendous labor savings.



Just state your individual problem. If you mix one material with another . . . reduce its size . . . separate one particle size from another . . . or handle material in bulk, you may realize considerable savings by consulting Sprout-Waldron. Our valuable ADAPTIONEERING service — **ingenuity + machines + experience** — is at your command. Sprout-Waldron & Company, Muncy, Pennsylvania.

SPROUT WALDRON
Manufacturing Engineers



With proper plant heat balance your steam may do two big jobs. If you generate steam for processing or heating a Troy-Engberg Steam Engine can produce By-Product Power at a very low cost. The same steam then yields power as well as heat units!

It's the simplest story in the plant. Steam is first passed through the engine—driving cookers, driers, cutters, pumps, blowers, compressors or generators. Then the exhaust, with most of the original heat units still intact, is used for processing or heating. And for dependability nothing beats the standard counterflow steam engine . . . no interruptions from power failure.

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TROY-ENGBERG

STEAM ENGINES • GENERATING SETS • GENERATORS

FOR MORE INFORMATION
See Reader Service Coupon on pages 169–170

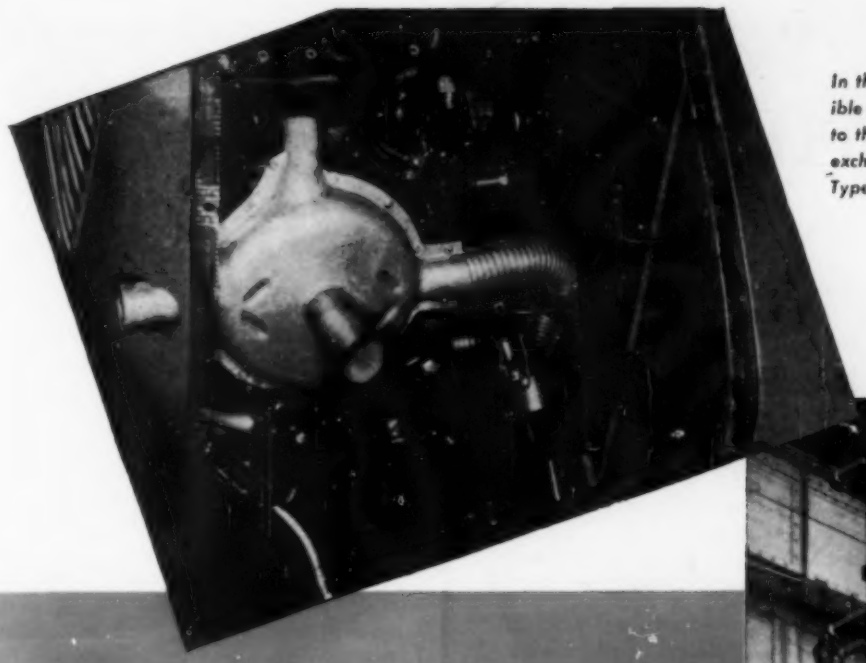
pattern making, carpentry work, luggage manufacturing, construction industries and furniture manufacturing.

59. Surgical Aid

NEWEST product of the blood fractionation process to be made available by Cutter Laboratories, Berkeley, Calif., is fibrin film, a uniformly thin, smooth, sheet-like material for use in plastic surgery. Made entirely of the coagulating elements of human blood, it may be left in the body without causing inflammation. Successful use has been noted in brain surgery as a satisfactory substitute when the membranes covering the brain or spinal cord are damaged or diseased. In such cases fibrin film is eventually vascularized and forms a permanent neomembrane. In plastic surgery and as a dressing for burns, drying and adhesions are prevented and removal is achieved without damaging the underlying healing area. The product is available in sealed, sterile tubes and does not require refrigeration. Preparation for use is accomplished by soaking in a sterile saline solution. Under such treatment, it becomes elastic, resembling a moist tissue membrane.

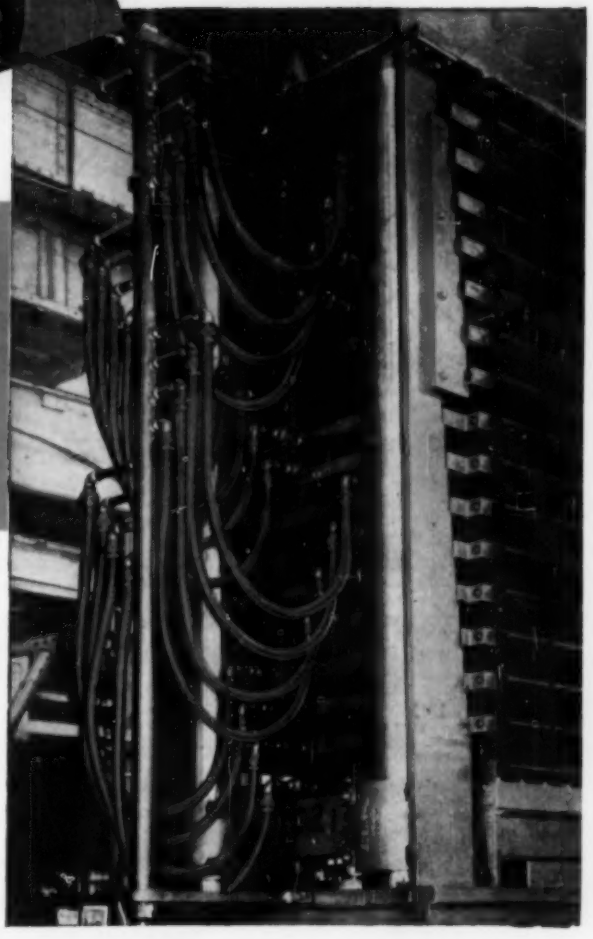
60. Redwood Bark Derivative

NOW AVAILABLE for laboratory and quantitative testing from Pacific Lumber Co., byproducts division, 100 Bush St., San Francisco, is Sodium Palconate, trade name for a new sodium salt of complex organic acids derived from the bark of the California giant redwoods. Aliphatic hydroxyls, phenolic hydroxyls and carboxyls in the ratio of 2:4:3 are contained in the product. Minimum molecular weight exceeds 900 and the conductometric neutralization equivalent is approximately 140. Surface tension is lowered appreciably when added to water and as a concentrated aqueous solution it becomes gel-like in structure. Conversion to the free acids is easily accomplished by passage of a dilute solution through a cation exchange column. Resultant free acids are more soluble in organic solvents and less soluble in aqueous solvents than Sodium Palconate, which may be classed as insoluble in organic solvents, highly soluble in water and only somewhat soluble in a 50 percent water-alcohol solution. In an aqueous state Sodium



In the new Ryan lightplane muffler, American Flexible Metal Hose conducts cold air from the air stream to the heat exchanger and warm air from the heat exchanger to the cabin heater. This hose is 2" O.D. Type UI aluminum.

Whether you put heat in, or take it out . . .



In this press that bonds plywood panels, 15 at a time, hot water is brought to the movable 100" x 50" hot plates through American Seamless Flexible Metal Tubing, reinforced with bronze braid and attached with brass couplings. Press manufactured by Williams, White & Co., Moline, Ill.

Flexible METAL HOSE Performs Best

What's *your* problem in flexible connections? Whether it involves vibration, misalignment or connecting moving parts while conveying steam, oil, water, other liquids, semi-solids or gases, you'll find a solution in the complete line of American Flexible Metal Hose and Seamless Tubing.

American Seamless Flexible Metal Tubing, as flexible as garden hose, and as leakproof as the seamless bronze tube from which it is made, is standard in sizes ⅛" to 4" I.D. *American Metal Hose* is available in brass, bronze, aluminum, steel and other metals, some of these in sizes up to 12" I.D.—made from strip in four spirally wound types. Either hose or tubing can be furnished complete with fittings to your exact specifications.

Detailed information is available on request, and our Technical Department will gladly cooperate on any unusual problems.

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Nothing can damage expensive pressure control equipment quicker than a bit of dirt, pipe scale, or foreign material in the working parts. Protect this expensive equipment by the proper installation of a good sturdy strainer in the line just ahead.
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A.W. CASH VALVE MFG. CORP.
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DECATUR ILLINOIS

Palconate is effective in removing zinc and aluminum ions from solution. It is mildly antiseptic to such organisms as *Aerobacter aerogenes* and *Bacillus mycoides*.

61. Piezoelectric Crystals

To REPLACE the natural quartz crystals used in long-distance telephone circuits, the Western Electric Co., Allentown, Pa., is producing ethylene diamine tartrate crystals. Known as EDT, these differ markedly in chemical composition from quartz. However, both are piezoelectric in character; that is, they can convert mechanical energy to electrical energy or they can reverse the process. A small plate of such a crystal will vibrate with unvarying frequency when electric current is applied to it. This quality may be employed in sending many telephone conversations over the same wires at the same time but at different frequencies, using crystal filters to guide each conversation into its proper channel. Artificially grown crystals weigh about a pound and are about 6 in. long with a 2x3 in. cross-section. The first seeds of crystal from which subsequent crops are harvested are only ½ in. across. They are obtained by evaporating a saturated solution of the chemical in a dish. Crystals so formed are then swished slowly back and forth in a supersaturated solution of the chemical to grow larger. A crop of crystals can be harvested every three months, and the seeds cut off from the new growth and replanted in the solution to start another crop.

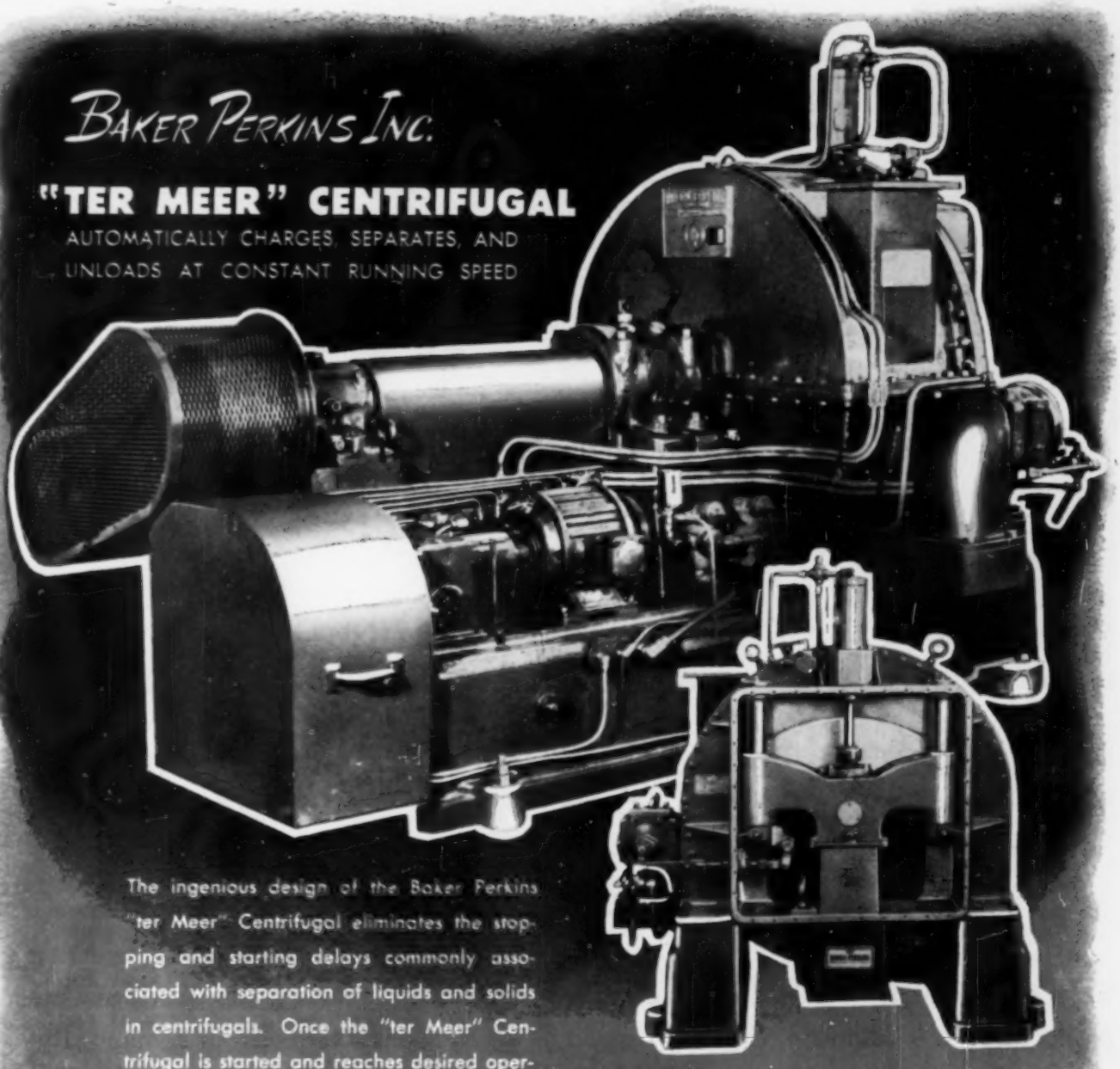
62. Penicillin Aid

More EFFECTIVE and more economical use of penicillin in combating bacterial infections is said to result when it is used in conjunction with caronamide. This new drug, with the brand name Staticin, manufactured by Sharp & Dohme, Inc., Philadelphia, Pa., acts temporarily to block the small tubes in the kidneys, so that if penicillin is administered at the same time as the Staticin it will not be excreted from the body as rapidly as if it were administered alone. A high concentration of penicillin in the blood stream for a longer period of time is especially desirable against highly resistant infections like typhoid fever, osteomyelitis and subacute bacterial endocarditis. Use of Staticin permits the rate of dosage of penicillin to be reduced to maintain adequate concentrations in the blood stream. A benzoic acid derivative, caronamide is technically known as 4-carboxyphenylmethanesulphonanilide.

BAKER PERKINS INC.

"TER MEER" CENTRIFUGAL

AUTOMATICALLY CHARGES, SEPARATES, AND UNLOADS AT CONSTANT RUNNING SPEED



The ingenious design of the Baker Perkins "ter Meer" Centrifugal eliminates the stopping and starting delays commonly associated with separation of liquids and solids in centrifugals. Once the "ter Meer" Centrifugal is started and reaches desired operating speed, the loading, separating, and discharging cycle is performed continuously as well as automatically. This constant running, automatic operation assures you of greater production with a minimum of power and labor. Illustrated is a Model HS-36 Baker Perkins "ter Meer" Centrifugal equipped with 4 cu. ft. capacity perforated filter type drum. Stainless steel and nickel operating parts. 10 HP main drive motor, 1 HP motor driven oil pump. Other Baker Perkins "ter Meer" Centrifugals are available with drums from 18" to 93" diameter, either perforated or solid type. Send us a description of your liquid-solid separation requirements, and we will be glad to recommend the Baker Perkins "ter Meer" Centrifugal specifically suited to speed and simplify processing of materials to precise specifications in your plant.

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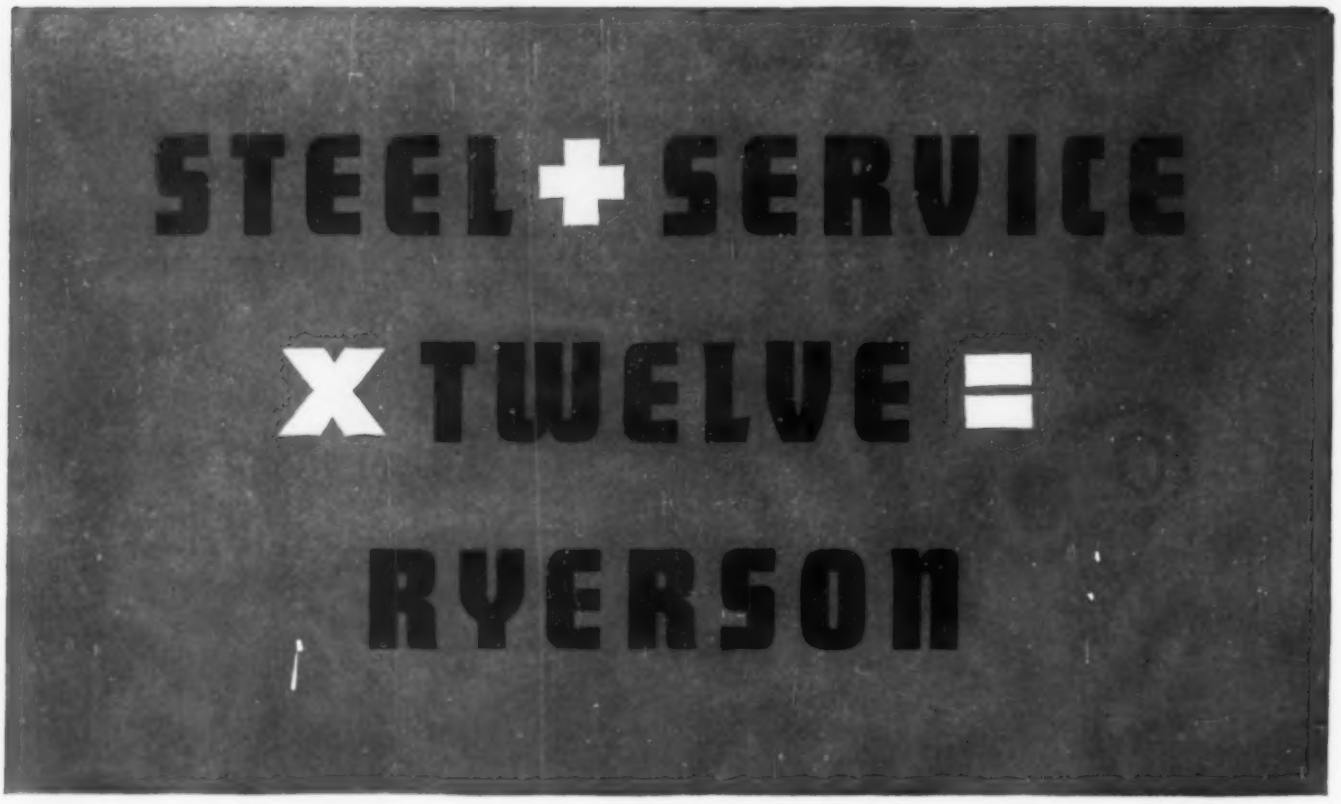
CHEMICAL MACHINERY DIVISION, SAGINAW, MICHIGAN



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CHEMICAL ENGINEERING NEWS

Richard F. Warren, ASSISTANT EDITOR

Westvaco Will Make Phosphorus in Idaho

PLANS for producing elemental phosphorus in an electric furnace plant near Pocatello, Idaho, are now complete, announces Westvaco Chlorine Products Corp. The first 15,000 kva. furnace is expected to be finished in early 1949. This development will tie in with Simplot fertilizer operations and later with Westvaco's soda ash plant near Green River, Wyo.

Phosphate rock will come from deposits in the Fort Hall Indian Reservation some 25 miles from the furnace site. Simplot holds a lease on the deposits. Phosphatic shales will be used in the furnace, which will be located adjacent to Simplot's present single superphosphate plant west of Pocatello.

Phosphorus output will at first be sent to Westvaco's plant at Carteret, N. J., for processing; company officials expect that this operation will eventually be carried out at its Wyoming plant. Excess phosphorus will be used by Simplot to produce fertilizers, and this firm has plans to build a phosphoric acid unit, and use sulphuric acid from Garfield, Utah. The soda-potash-phosphate-sulphuric possibilities of the Idaho-Wyoming-Utah area are expected to give rise eventually to a substantial chemical fertilizer industry.

Bakelite Corp. Completing New Expansion Program

PLAN CONSTRUCTION OF THREE PLASTICS PLANTS TO INCREASE PRODUCTION FACILITIES DURING 1948

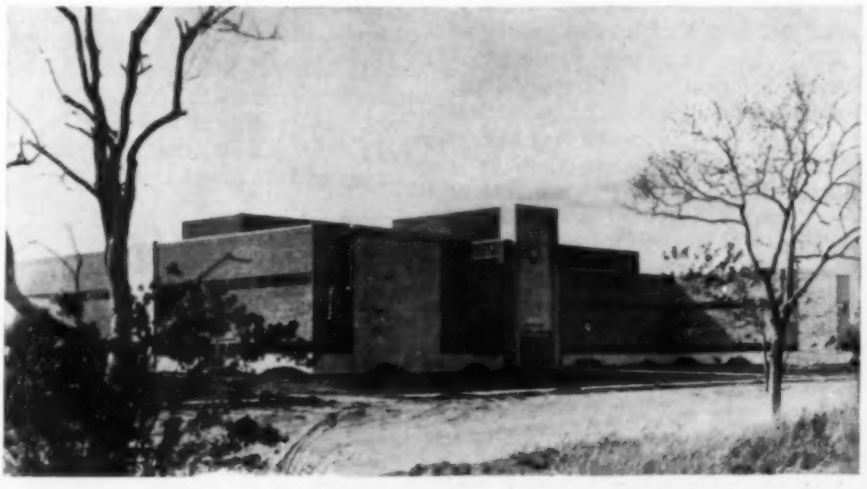
AN EXTENSIVE program for the expansion of plastics manufacturing facilities of Bakelite Corp., is scheduled for completion during 1948. Facilities for production of all plastics and resins marketed by the corporation will be increased by 50 to 60 percent. On individual products, increases will range from 30 to 400 percent. The program includes construction of three new plants and expansion at three of the corporation's existing plants.

A new works at Ottawa, Ill., for processing vinyl resins into plastic film, sheeting and rigid sheets has been built and some production is already under way. The plant is expected to be in full production next spring. Production of vinyl resins at the South Charleston, W. Va., plant has been substantially increased. The new Texas City, Tex., plant which also produces vinyl resins is now in operation. Greatly increased output of polyethylene resins at the South Charleston, W. Va., plant and the correspondingly increased use for this new plastic resulted in price reductions in June and November last year.

Expansion is also in progress at Bound Brook, N. J. By June, this plant will be ready to produce polystyrene at the rate of 25 million pounds annually. All production of polystyrene at the Bloomfield, N. J., plant is being transferred to Bound Brook. By May, facilities at Bound Brook for the manufacture of phenolic molding materials alone will be increased by 30 percent.

Enlargement and modernization of the development laboratories at Bound Brook will be completed soon.

A new plant at Monterrey, N. L., Mexico, recently began operation for the production of general-purpose phenolic molding materials. Another new plant is being constructed in Canada, near Belleville, Ontario. This plant of Bakelite Co. (Canada) Ltd., is expected to be completed the latter part of 1948. Phenolic plastics and resins and urea resin glues, which are now made at the Toronto plant, will be produced there.



Petroleum exploration and production research will be centralized in Shell Oil Co's. new Houston laboratory

NEW SHELL OIL LABORATORY DEDICATED IN HOUSTON

SHELL OIL CO.'s new Exporation and Production Research Laboratory, costing over $1 million, was dedicated in Houston, Tex., on December 5. The new laboratory, one of the largest of its kind in the world, has been built to centralize the company's expanding program of research to develop new and improved methods of exploring for petroleum and producing the product from the earth. The laboratory was engineered and constructed by The Austin Co.

The Research Division consists of

three departments: Chemical, Physical and Geological. The Chemical Department is composed of four sections. Examination of clays is centered in the Rock Chemistry Section. Another group, which is concerned with the physical chemistry of rocks, performs research in such fields as porosity, permeability and surface tension phenomena. A third section specializes in pressure-volume-temperature relationships of hydrocarbons. The fourth group, the Analytical Section, performs analytical work and its equipment includes complete microchemical and electrometric facilities, an emission spectrograph, an infrared spectrograph and an ultraviolet spectrograph.

Harold Gershinowitz is director of the company's Exploration and Production Research Division. Other administrative staff members include M. King Hubbert and J. P. Murphy, both associate directors; Noyes D. Smith, Jr., laboratory manager; and W. L. MacKinnon, office manager.

New equipment and uses for industrial gases in production and finishing of steel products are among research activities being conducted by Air Reduction Co. at this new apparatus research laboratory in Murray Hill, N. J. Processes being studied include flushing of molten metals, hot cutting of blooms, helium protected welding and photoelectrically controlled automatic cutting

More Stable Isotopes Are Available

NEW tools for research are the 100 stable isotopes of 29 elements which the Atomic Energy Commission announced last month were available for distribution to research labs.

They're recommended for industry mainly as tracers where the radioisotope of the element has such a short half-life that it's unsuitable for research purposes. Good example is copper. The half-life of Cu-64 is 12.8 hr. Cu-63, the stable isotope, can be used over a period of years.

AEC states the new situation graphically. Heretofore, stable isotopes have been concentrated in quantities too small to be seen with the naked eye; now through use of the equipment at Oak Ridge, it's possible to concentrate amounts of isotopes that can be weighed and handled like ordinary rare chemicals.

The elements: lithium, boron, carbon, magnesium, silicon, chlorine, potassium, calcium, titanium, chromium, iron, nickel, copper, zinc, germanium, selenium, bromine, zirconium, molybdenum, silver, cadmium, indium, tin, antimony, tellurium, tungsten, thallium, and lead.

Stable isotopes will be furnished to labs only on a loan basis; first priority will go to those investigations which do not use up or adulterate the material. The reason: AEC has limited supplies, and the production cost is high. Cost to the user is $50 for each sample. But when the investigation is complete, or the time alloted has expired, the unadulterated isotopic material must be returned to Oak Ridge.

A McGraw-Hill survey of industry's use of radioactive isotopes reveals that, a year after they first became available, they're still being used mainly in basic research. Indications are, however, that within another year design, production, and process engineers will be using them routinely for material analysis.

Scarcity of radioactive isotopes is no longer a barrier. During recent months the Atomic Energy Commission has met all reasonable demands; they've not had to limit distribution to high-priority research projects.

U. S. Rubber Co. Closes Institute GR-S Plant

U. S. RUBBER CO. has terminated production at the government synthetic rubber plant it has operated for the past four and one-half years at Institute, W. Va. Special grades of GR-S rubber previously produced at Institute, including black types (containing carbon black) and non-staining types, will henceforth be made at the plant operated by the company in Borger, Tex. Some of the special plant equipment for making black GR-S will be moved to Borger. Supervisory personnel have been or will be transferred to the company's other plants. Plant maintenance personnel will remain at the plant for about six months to pack machine parts in preservatives and place the plant in a standby condition.

The Institute plant was the first large synthetic rubber unit to start regular production of the critical war material. It started production on Mar. 31, 1943. When production ceased on November 10 this year, the plant had made 358,537 long tons. During the war the plant used butadiene made from alcohol at a plant in Institute adjacent to the rubber plant. When the government decided after the war to use only butadiene made from petroleum, the nearest sources to Institute were in Louisiana and Texas.

Pfizer Leases Vigo Plant in Indiana

IN DECEMBER, Chas. Pfizer & Co., Inc., signed a 20-yr. lease with the government covering the Vigo plant, Terre Haute, Ind. Last month the plant was formally transferred to the company. The property includes the Vigo plant property and the associated utilities covering 300 acres. The remainder of the post is being transferred by the Army to the WAA. The company plans to utilize the plant promptly for the production of antibiotics, such as penicillin and streptomycin, and as well for the manufacture of certain fine chemicals. This will supplement the operations of Pfizer at its plants in Brooklyn, N. Y., and Groton, Conn., and permit manufacture of two products now in pilot plant phase.

Reichhold Plans World Wide Expansion Program

AT THE annual meeting of Reichhold Chemicals, Henry H. Reichhold, chairman of the board, announced that the corporation will spend approximately $10 million for expanding and enlarging the company's production facilities. The money will be used for increasing production

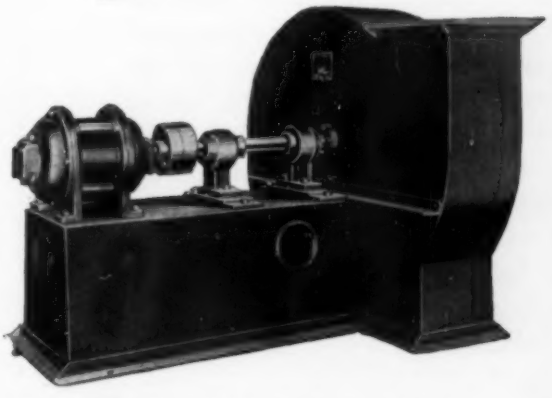
Exhaust THESE FUMES—

FANS by "Buffalo"

Sulphuric	Acetic	Zinc Sulphate
Sulphurous	Citric	Ferrous Chloride
Carbonic	Tannic	Caustic Potash
Hydrobromic	Chlorine	Calcium Hypochlorite
Hydrofluocilicic	Chromic	Copper Sulphate
Phosphoric	Oxalic	Zinc Chloride
Pyroligneous	Tartaic	Ferrous Sulphate
Bromine	Formaldehyde	Sodium Acid Sulphate
	Muriatic (Hydrochloric)	

"Buffalo" RUBBER-LINED FANS

CAN *"Take it"!*



• The fumes above quickly destroy metal housings, rotors, shafts, and bearings—but not rubber. That's why "Buffalo" Rubber-Lined Fans last from three to twelve times as long as metal fans on these jobs!

These "Buffalo" fans are lined with pure, live rubber on every part exposed to fumes. The rubber coating will not become hard or brittle, or separate from the metal. It is "welded" on by the famous B. F. Goodrich "Vulcalock" method—has an adhesion strength of 700 lbs. to the square inch.

Put "Buffalo" Rubber-Lined Fans on your corrosive fume-removal jobs. They are available in all types and sizes in typically high-efficiency "Buffalo" design that performs maximum removal with minimum power. And their rubber lining feature will multiply their useful life.

"Buffalo" engineers will be glad to recommend the right fan for your particular fume problem. Simply write:

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- ★ COMFORT COOLING
- ★ PROCESS COOLING
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- ★ AIR WASHING
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- ★ BLOWING
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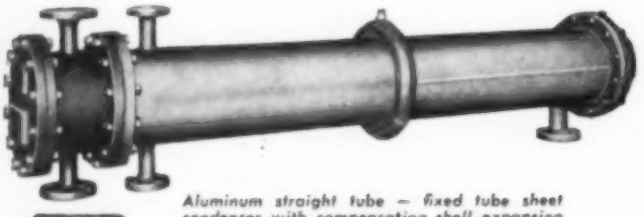
WHITLOCK Heliarc welding technique has been designed to overcome those old bugaboos of non-ferrous welding — porosity and poor physical qualities. Heliarc welds by Whitlock are of quality equivalent to A.S.M.E. U-68 standards — suitable for X-ray examination. Typical Whitlock Heliarc copper welds show a tensile strength of 30,500 p.s.i. — give free bend tests in excess of 30% and elongations of 35%. In addition to copper welds up to ¾" thick, consistently strong Heliarc welds have been made by Whitlock in aluminum to 1⅜" and Everdur full penetration flange-shell joints to 2½" thickness. New applications for the Whitlock Heliarc method are constantly being developed through research and production. Our engineers will gladly show how this technique can be applied to your own non-ferrous exchanger and vessel requirements. Write for information.

Heliarc welded Everdur hydrochloric acid stripping column section — one of twelve making up a 43 ft. column.



Aluminum straight tube — fixed tube sheet condenser with compensating shell expansion member. All aluminum welds by the Heliarc method.

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capacity at plants in Detroit, Elizabeth. N. J., Brooklyn, South San Francisco, Tuscaloosa, Ala., Seattle, Liverpool, Paris, Sydney, Rio de Janeiro, Milan and Zurich. It will also be used for the building of additional plants in this country to increase the available amounts of certain new materials. Raw material scarcities have curtailed the company's production of synthetic resins, color pigments, phenolic plastics and industrial chemicals and it is believed that the new plants will, to a major degree, eliminate these retarding influences.

Last year Reichhold opened new plants in Seattle for the manufacture

CONVENTION CALENDAR

Chemical Market Research Association, winter meeting, Mayflower Hotel, Washington, January 22.

American Standards Association, Seminar on Standardization, Engineering Societies Bldg., New York, January 26-30.

Association of American Soap and Glycerine Producers, Waldorf-Astoria Hotel, New York, January 28-29.

National Materials Handling Exposition, Public Auditorium, Cleveland, Ohio, January 12-16.

American Society of Heating & Ventilating Engineers, eighth international heating and ventilating exposition, Grand Central Palace, New York, N. Y., February 2-6.

American Institute of Chemical Engineers, regional meeting, New Orleans, La., February 15-19.

Technical Association of the Pulp and Paper Industry, national meeting, Hotel Commodore, New York, N. Y., February 23-26.

National Association of Corrosion Engineers, fourth annual conference, Jefferson Hotel, St. Louis, Mo., April 5-8.

Third Southern Machinery and Metals Exposition, Municipal Auditorium, Atlanta, April 5-8.

Midwest Power Conference, sponsored by Illinois Institute of Technology, Sheraton Hotel, Chicago, April 7-9.

American Chemical Society, 113th national meeting, Chicago, Ill., April 19-23.

American Oil Chemists' Society, spring meeting, New Orleans, May 2-6.

American Institute of Chemists, annual meeting, Hotel Pennsylvania, New York, May 8.

Second Engineering Progress Show, Franklin Institute, Philadelphia, May 11-16.

FROM SHELL CHEMICAL

ALLYL ALCOHOL

($CH_2=CH-CH_2OH$)

AVAILABLE IN TANK CARS AND DRUMS

A highly versatile intermediate. Its olefinic double bond and hydroxyl group may be reacted separately or simultaneously to form a host of useful compounds

THE REACTIVITY of Allyl Alcohol, either as an alcohol or an olefin, is considerably greater in most cases than that of saturated primary alcohols or simple olefins. Therefore a larger number of derivatives are more readily obtainable.

DIRECT DERIVATIVES of Allyl Alcohol include oxidation and reduction products, chlorohydrins, ethers, polymers, and esters of a variety of organic and inorganic acids.

RESINOUS POLYMERS are among its most important derivatives. Esters of dibasic acids or of acids containing conjugated double bonds readily polymerize in the presence of suitable catalysts. These polymers vary from viscous liquids to clear, hard thermosetting plastics.

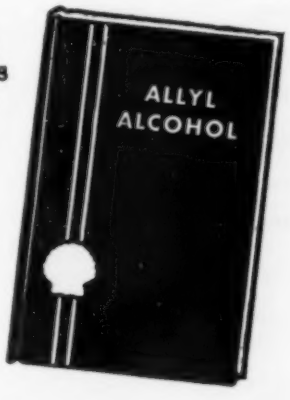
A request on your business letterhead will bring a copy of Technical Book SC: 46-32.

PHYSICAL PROPERTIES

Specific Gravity 20°/20°C	.8535
Boiling Point (760 mm)	96.9°C
Flash Point (open cup)	90°F
(closed cup)	72°F
Refractive Index, N_D^{20}	1.4133
Aqueous Solutions	Completely miscible with H_2O. Constant boiling mixture at 88.9°C, containing 72.3% by weight allyl alcohol

SPECIFICATIONS

Purity	Minimum 98% by wt.
Specific Gravity (20°/20°C)	.852 to .855
Color (platinum-cobalt scale)	Maximum 15
Water	Maximum .3%
Distillation Range	Below 95°C: None Above 98°C: None



Among the many other Shell Chemical products are Allyl Chloride, Epichlorohydrin, Glycerol Dichlorohydrin, Acetone and Diacetone Alcohol

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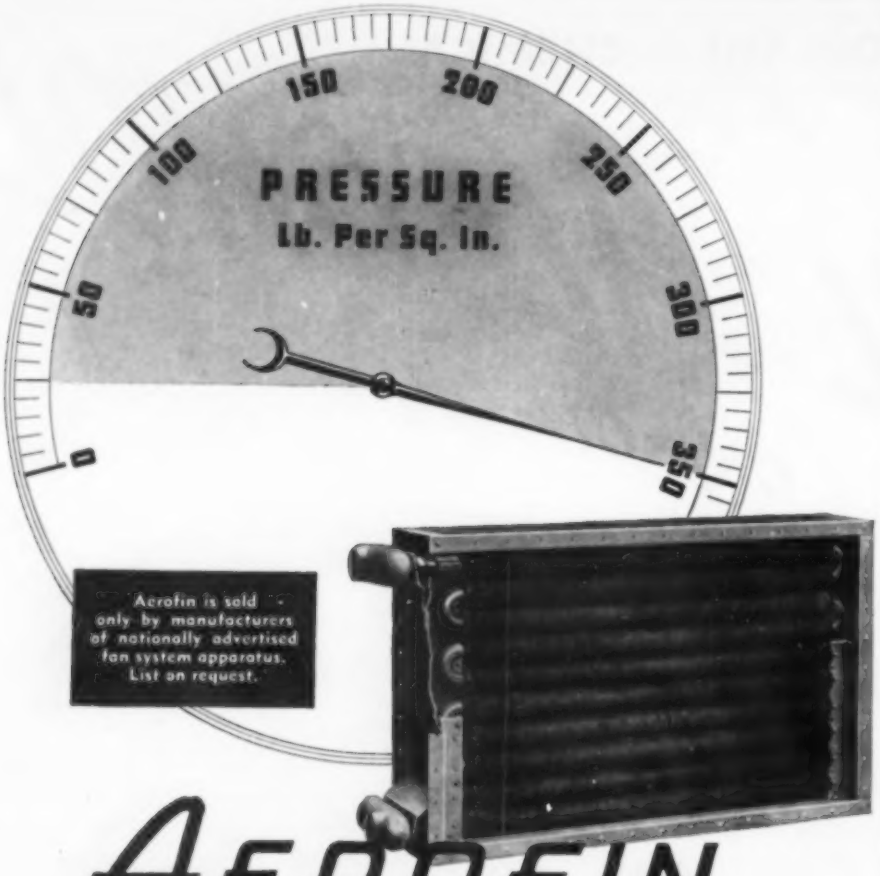
Los Angeles • Houston • St. Louis • Chicago • Cleveland • Boston • Detroit



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HEAVY DUTY HEATING COILS

Specially designed for use where extra-rugged coil is needed for close control. Continuous tube type. Operating pressure 25 to 350 p.s.i., temperature up to 350° F. Pressed steel headers, heavy copper tubing and fins, galvanized-iron casings. Highly efficient. Fast heating. Compact. Write for complete ratings and specifications.

Types for all Applications

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CLEANABLE TUBE with easily removed headers.
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of phenolic adhesive resins, in Tuscaloosa, for the making of chemical color pigments, in Elizabeth, N. J., for the production of maleic anhydride and in Zurich, Switzerland, and Milan, Italy, for the processing of synthetic resins. A synthetic resin plant is under construction in Rio de Janeiro and another will be started early this year in Mexico City.

Market Research Group Holds New York Winter Meeting

MEETING at the Hotel Biltmore, New York, the Chemical Market Research Association held its winter meeting on December 10. Frederick W. Sullivan, consulting chemist and K. S. Nelson, Standard Oil Co. of N. J., spoke on hydrocarbon synthesis. Warren C. Hyer, York Research Corp., spoke on market research techniques in the chemical industry. Edward R. Dewey, author of "Cycles," spoke on cycles as a new tool of business forecasting at a dinner session.

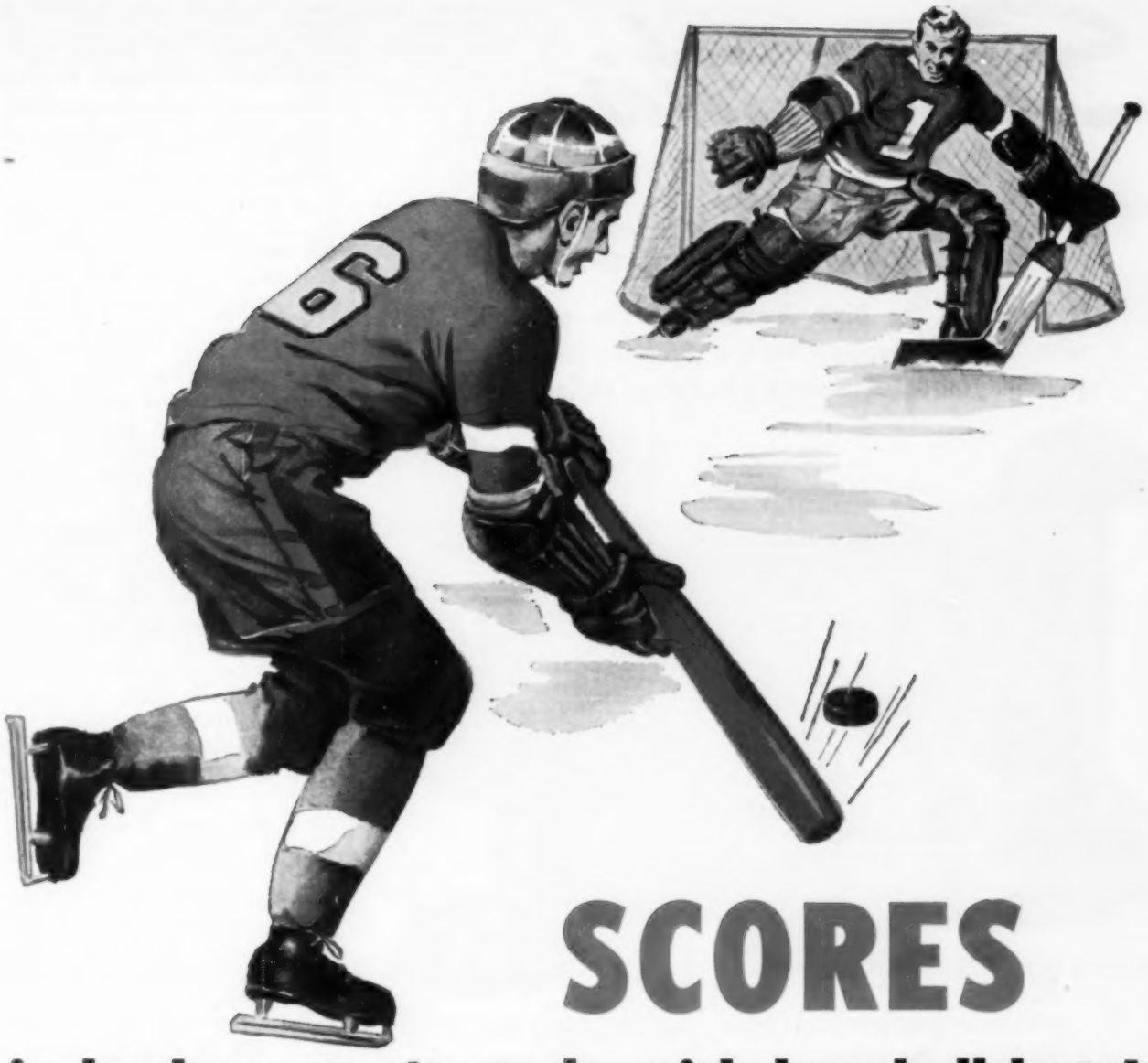
The association is planning to hold its next meeting at the Mayflower Hotel, Washington, D. C., on January 22. This meeting promises to be of considerable importance to chemical market and sales analysts, because of the number of talks scheduled by government officials.

Survey Shows Expansion of Oklahoma Glass Industry

OKLAHOMA'S glass manufacturing industry is rapidly expanding. A survey recently completed by the Tulsa Chamber of Commerce with the cooperation of other similar organizations and glass companies indicates that new capital expenditures in the industry announced in 1947 and projected into 1948 total about $6.5 million. Among the major expansion programs is that of Corning Glass works, $1.7 million; American Window Glass Co., over $1 million; and Pittsburgh Glass Co., $1.5 million. Most glass makers operating in Oklahoma have developments under way.

Corning is building a new plant at Muskogee which is expected to be in operation early in 1948. This plant will operate one continuous glass furnace and produce, at the start, Pyrex glass. American Window Glass is rebuilding and enlarging a plant at Okmulgee which has been idle for some time. It is contemplated that operations will begin this spring with three Fourcault sheet glass drawing machines and other equipment will be added later.

Pittsburgh Plate Glass Co. is enlarging its Henryetta plant. As originally



SCORES

in hockey aren't made with baseball bats!

The business of making "home-runs" calls for much different equipment than that with which "goals" are scored.

Even though baseball bats and hockey sticks are both made of wood, they are "engineered" for different objectives. The various physical and chemical characteristics that make MOSINEE papers win in a wide range of highly specialized industrial uses, are also definitely engineered into these essential papers. MOSINEE paper technicians are equipped with scientific laboratory and production controls, plus practical "know how" based on broad experience in creating papers of many characteristics, such as extreme stretch without loss of tensile strength, high absorbency, moisture repellency, controlled pH for desired alkalinity, acidity, or neutral reaction, etc.

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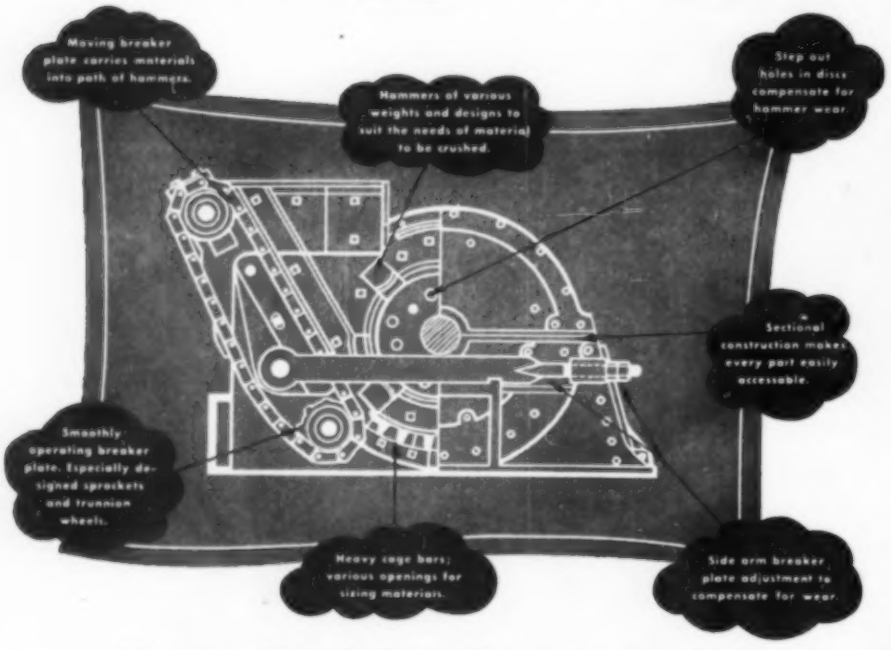
Study this Construction

It identifies the Dixie Hammermill, the only mill with the Continuously Moving Breaker Plate*... your guarantee of *greater* production at less cost.


Moving breaker plate carries materials into path of hammers.
Hammers of various weights and designs to suit the needs of material to be crushed.
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Sectional construction makes every part easily accessable.
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Heavy cage bars; various openings for sizing materials.
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Wherever Dixie Hammermills are installed, the results are the same; costs go down, output goes up, costly shutdowns are eliminated... the quality of the finished product is improved. If you have wet, sticky material to crush, if you have difficulty in reaching and maintaining desired production, if you have any crushing problem at all, it will pay you to take advantage of Dixie's patented crushing principle. No other hammermill performs like a Dixie... none can match it for efficiency and economy. We've prepared a booklet titled "More Efficient Crushing of Raw Materials" that interestingly sums up Dixie's unique, money-saving features. Request your copy today.

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constructed, the plant had two tanks, but only one has been in use, but late in December the second tank was fired. New construction required to maintain both tanks in operation consists primarily of storage bins, doubled cutting and packing facilities and additional storage space.

Steps are being taken to increase the availability of raw materials for the expanding glass industry. The Pennsylvania Glass Sand Corp. has purchased the property of the Mill Creek Sand Co. at Mill Creek, Okla., and is building a plant to produce silica sand suitable for the manufacture of high quality glass. The Rock Products Manufacturing Co. has installed facilities to make available large quanities of Oklahoma "Rover" dolomite

An indication of the growth of the glass industry in Oklahoma, which is to an important degree attributable to cheap natural gas, lies in the fact that whereas production of silica sand was only 80,400 tons in 1941, production rose to 130,000 tons in 1944. The Tulsa Chamber of Commerce estimates that glass plants in Oklahoma, Kansas, Arkansas and Texas could use 300,000 tons per year.

New Refinery To Be Built At Salt Lake City

As THE initial step in a long-range program to serve the intermountain area, Standard Oil Co. of Calif., San Francisco, has announced plans for the immediate construction of a refinery at Salt Lake City. Designed capacity will be 25,000 bbl. of crude daily and the cost has been estimated at more than 5,000,000. Completion, scheduled within the next twelve months, will coincide with the first deliveries of Rangely, Colo., crude over a new $5,000,000 pipeline. Surveys for this line are virtually completed and construction will be started as soon as possible.

AIChE Will Hold Regional Meeting in New Orleans

THE New Orleans regional meeting of the AIChE will be held on February 15-19. Symposiums will be held on high temperature refractories and low temperature insulation. More than twelve technical papers will be presented. W. E. Lobo, M. W. Kellogg Co., is arranging for the papers.

Plant visits will include trips to Shell Oil Co., Inc., at Norco, La.; Godchaux Sugar Refinery at Reserve, La.; Flintkote Co. and Lone Star Cement Corp. in New Orleans; Johns-Manville Corp., Celotex Corp. and Hercules Powder Co. in Marrero, La.;

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This low-cost process water in your plant means better products, the ILLCO way

OPERATING PRINCIPLE—Raw water passes in series through two reactor tanks containing high-speed, high-capacity ion-exchange resins. These resins have the property of adsorbing and exchanging all the cations and anions in the water supply, giving an effluent water that is equal in purity to distilled water. No heat, no fuel, no cooling water involved in the process. Units are compact, requiring small floor space and little attention. There are only a few simple valves and minimum piping. The range of flow rates is practically limitless. Water is used here as an example, but the same operating principle applies to the De-ionization of any liquid.

If you've overlooked the remarkable development of ILLCO-WAY ionXchange, get the facts today. Countless products are now *better and less expensive* because manufactured with the aid of ILLCO-WAY De-ionized Water. This replaces distilled water at *a fraction of distilled water's cost*—provides 10,000 gallons of pure water for less than a dollar, the ILLCO way! Hundreds of up-to-date plants—pharmaceutical, chemical, cosmetic and the like—are obtaining pure, low-cost process water from compact equipment—which also serves many other fields outside of water conditioning. Write for the basic facts of ILLCO-WAY ionXchange today—indicate your manufacturing problem so we can send specific literature.

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ENGINEERING AND EQUIPMENT DE-IONIZERS for process water treatment and treatment of liquids and solutions other than water; waste treatment; reclamation of specific constituents. DE-ALKALIZERS: Boiler feed (external); bottling water. SOFTENERS: Industrial, domestic. FILTERS, etc.

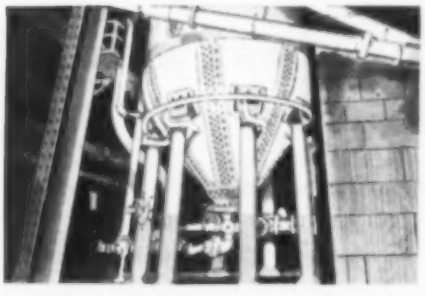
To keep out corrosion... brush on UCILON!

Users tell us Ucilon 400 resists *more* corrosives for *longer* periods than any other coating tried!

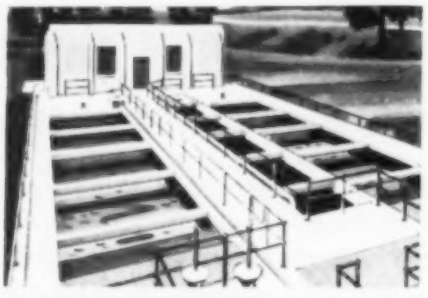
TIME AND AGAIN, Ucilon 400 has stood up under the severest conditions—long after other maintenance coatings had failed!

For though it's brushed on (or sprayed) like paint, Ucilon 400 is no ordinary coating. This plastic-based coating of the Ucilon group (which also includes aluminum and baking synthetic types) resists acids, alkalies, oils, water, alcohols, salts and many other destructive solutions and fumes. Ucilon 400 has excellent flexibility, no taste or odor when dry—and sticks fast to concrete, metal or wood.

When you try to fight powerful corrosives with anything less, you lose money and waste equipment. Pick out your toughest problem area, as a first step, and let Ucilon do the job correctly. You'll be surprised to learn how much it can save you on maintenance throughout your plant.



A PAPER MILL tried Ucilon 400 on a pulp feeder chute that had required excessive maintenance under the constant motion of the solution of paper pulp, soda ash and water at 140° F. Though just a prime coat and one top coat were used, Ucilon still lasted *3 times* longer than any former coating!



SEWAGE TREATMENT WORKS have found the answers to many tough jobs in Ucilon. In the sedimentation tank of one plant, for instance, Ucilon 400 was totally unaffected after 5 months of constant exposure—enough proof that Ucilon 400 is the coating they want for *every* new tank!

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Freeport Sulphur Co. in Port Sulphur; Jefferson Island Salt Co., Bay Chemical Co., Inc., and McIlhenny Gardens near New Iberia, La.; Hercules Powder Co. at Hattiesburg, Miss.; and Masonite Corp. at Laurel, Miss.

Rust Enters Chemical Process Design Field

FORMATION of a new process engineering division has been announced by Rust Engineering Co., Pittsburgh, Pa. The new division will offer design facilities covering all phases of chemical process work, as well as purchasing and construction of process plants. Process engineers who will direct the new program are: Dr. John A. Patterson, Dr. W. W. Waterman, Leonard A. Wasselle and Walter L. Bass.

Heyden Making Additional Hydrocarbons at Memphis

PRODUCTION of ortho and paradichlorbenzene is under way at the Heyden Chemical Corp. plant in Memphis. This plant now produces chlorine, liquid caustic soda, hydrogen, and monochlorbenzene as well as the two new chemicals. Trichlorbenzene production is expected soon.

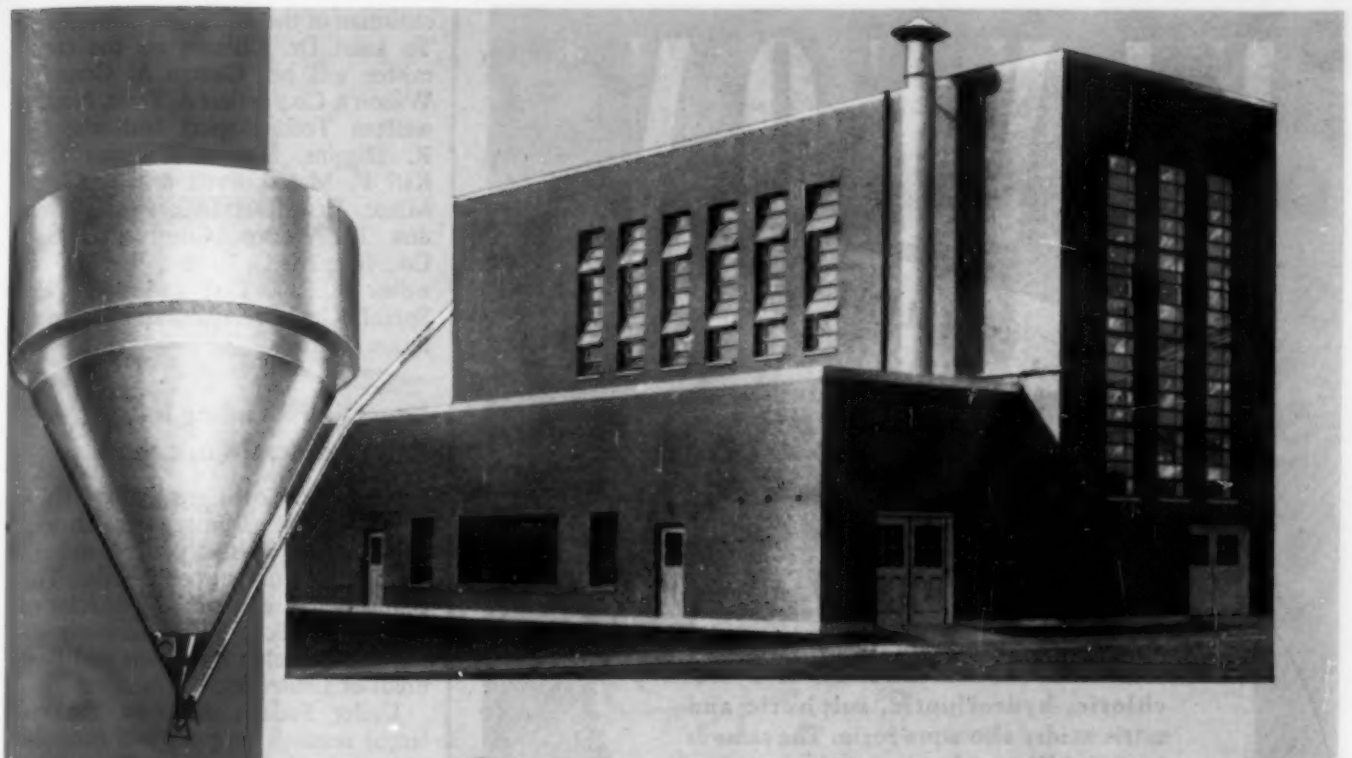
Pineapple Juice Processed In Ion Exchange Plant

HAWAIIAN chemical recovery of waste-pineapple byproducts, after six years of research and another year of ion exchange pilot plant work, has become a reality. Some 4,000 tons of natural sugar annually and increased yields of citric acid are being extracted at the new $750,000 Iwilei Island plant of Hawaiian Pineapple Co., Ltd., completed last fall. Only citric acid and livestock feed were formerly obtained.

Plant design follows that of a $50,000 pilot plant, capable of handling 3,000 gal. of juice daily, announced last year. Equipment for the larger unit began to arrive last March and installations started in May. Present capacity is 300,000 gal. each 20-hr. day; and on this basis 0.75 lb. of sirup are recovered from each gallon of raw juice. Cycle time is one hour based on a maximum run.

Chemical Exposition Coming To Chicago in October

FIFTH National Chemical Exposition, sponsored by the Chicago section of the ACS, has been set for October 12 through 16 at the Chicago Coliseum. Dr. L. E. Clifcorn is



Swenson Spray Drying

NOW PROVED APPLICABLE

to chemicals with widely differing characteristics

These are but a few of the many products that have been successfully spray dried:

- Alfalfa extract
- Animal blood
- Calcium carbonate
- Distillery slop
- Dyes and dyestuffs
- Magnesium carbonate
- Manganese sulfate
- Pentaerythritol
- Pharmaceuticals
- Pigments
- Polyvinyl Resins
- Starch (textile)
- Sulfite waste liquor and lignins
- Tannin liquors
- Zinc sulfate

Where Swenson Gray-Jensen spray drying can be applied to chemical processes and products, it offers certain important advantages:

1. Instantaneous conversion of liquids to solids in a single pass
2. Conversion at low temperatures
3. Solids delivered in the form of powders that require no crushing or sifting
4. Prevention of both contamination and chemical loss by a closed system
5. Low cost production

Since the Swenson Spray Dryer Research Plant began operations early this year, tests have been made almost daily—in co-operation with numerous concerns in the process industries—to determine the practicability of spray drying chemical, food, and dairy products. The list at left represents only a few of the diversified chemicals which have been successfully dried on a full-scale operating basis.

If you have a product which can benefit from the advantages of spray drying, ask us at once for a consultation.

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. . . EXCELLENT FILTER MEDIUM FOR MINERAL ACIDS AND MINERAL ALKALIES

Tests show "excellent resistance—no attack" with all concentrations of hydrochloric, hydrofluoric, sulphuric and nitric acids; also aqua regia. The same is true of sodium and potassium hydroxides; chlorine and bromine waters; potassium permanganate and dichromate; silver nitrate and tannic acid. VINYON* can handle many oils, fats and waxes. It will not support bacteria and fungi.

The temperature limit for VINYON* is a little lower than that of its companion plastic fiber medium, SARAN†, being about 150° F. Above this temperature shrinkage occurs.

Why not order a test sample of VINYON* and see if it is better chemically than the filter medium you are now using. Mechanically it is strong and the weaves are such as to give excellent filtering results. In writing for your sample, tell us about the products to be filtered.

† TM Dow Chemco

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chairman of the exposition committee. To assist Dr. Clifcorn on the committee will be: George A. Crapple, Wilson & Co.; Arthur A. Frost, Northwestern Technological Institute; R. R. Higgins, Sherwin-Williams Co.; Karl F. Mattil, Swift & Co.; C. S. Miner, Jr., Miner Laboratories; Gordon T. Peterson, Continental Can Co., Inc.; M. C. Rogers, R. R. Donnelley & Sons Co.; and J. Robert Spraul, General American Transportation Corp.

Lion Oil Expanding Its Petrochemical Work

LION OIL CO. is greatly expanding its program of chemical research and development, with particular emphasis on the field of petrochemicals. The company has selected as its director of research Frank J. Soday, formerly director of research for Devoe and Raynolds of Louisville.

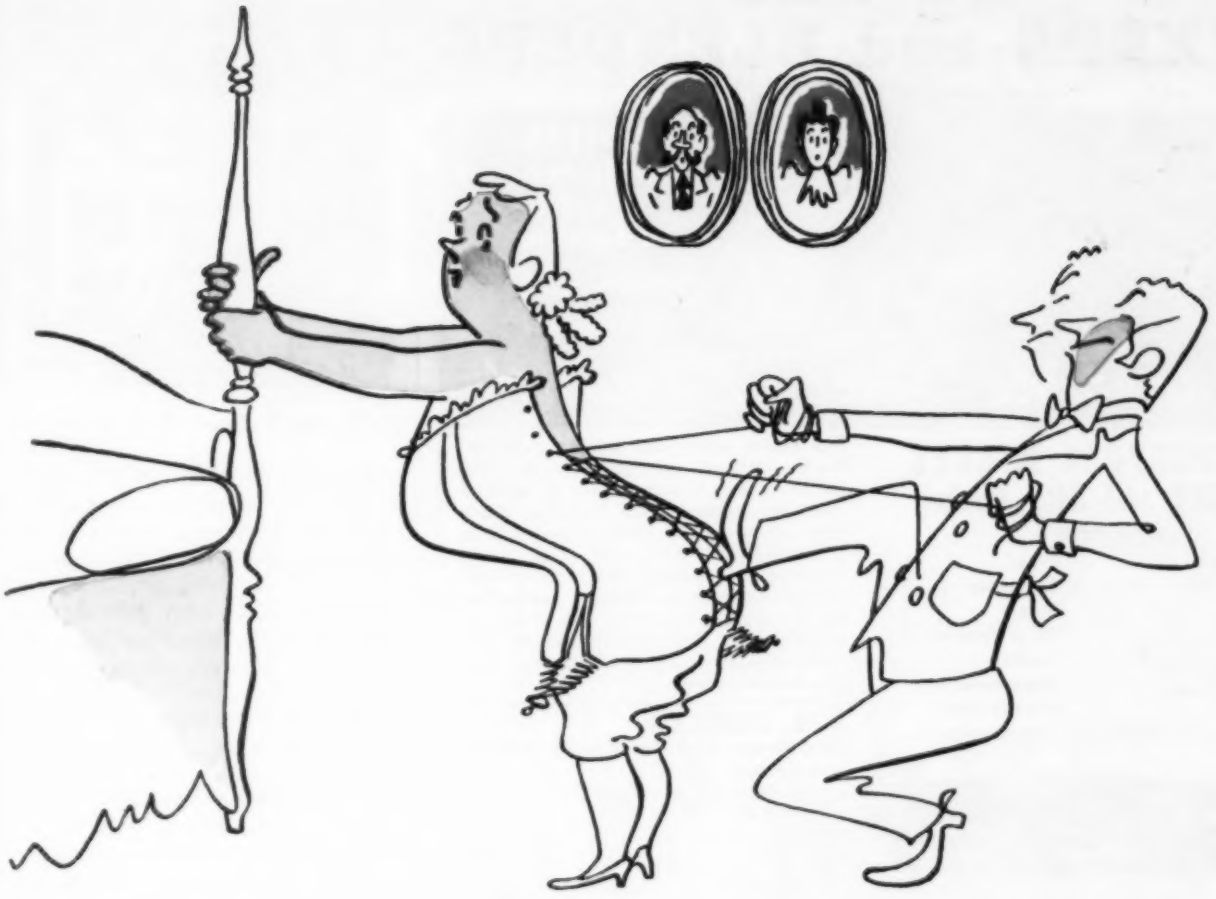
Under Soday's direction the enlarged research program will function independently as a separate research body, and from the standpoint of organization will be responsible directly to the company management rather than to company plants or divisions. Separate research facilities are being set up at the company's chemical plant near El Dorado, Ark.

Dorland Reelected President Of Organic Group

ELECTION of officers was held at the annual meeting of the Synthetic Organic Chemical Manufacturers in New York. Ralph E. Dorland, Dow Chemical Co., was reelected president. Dr. E. H. Killhoffer, E. I. du Pont de Nemours & Co., and Dr. Eric C. Kunz, Giuvaudan-Dellawanna, were elected first and second vice presidents, respectively. Other officers elected were A. Merz, American Cyanamid Co., reelected to the board of directors; C. M. Richter, Pharma Chemical Corp., treasurer; H. W. Smith, Union Carbide & Carbon Corp., and T. H. Roberts, Arnold Hoffman, Inc., all new members of the board. High light of the meeting was a discussion of the recent reduction of import duties on chemicals.

Sherwin-Williams Completes New Extraction Plant

A NEW solvent extraction plant has been completed by Sherwin-Williams Co. in Cleveland. It will make the company independent of outside castor oil supplies. The plant employs a new extraction process developed by the



The Case of the Controlled Contours

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McKay Electrodes have the particular properties needed for proper regulation of bead contour, as well as weld metallurgy and arc action.

With McKay Electrodes, the operator lays down beads which are the exact size and shape required by the job. The weld metal is metallurgically sound, free from slag inclusion and has the correct mechanical properties.

Thus McKay Electrodes assist in producing stronger structures with less weld metal and lower finishing costs. *See for yourself. Test McKay Shielded-Arc Electrodes on your next job.*

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Wgt. Capacity 1000 lbs.

8 SIZES
RANGE FROM 100 lbs. TO 5000 lbs.
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ALL PURPOSE MIXERS For WET and DRY Mixing

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Powders	Drugs
Chemicals	Cosmetics
Bakery Mixes	Glue
Paint	Oil & Greases
Flour Blending	Colors
Poultry Foods	Marshmallows
Stock Feeds	Plastics (dry)
Soaps	Floor-Sweep
Processing Seeds	

No matter what your mixing problem, the Do-All will help you solve it. Built for extra long life they have all welded steel construction, ball bearings, chain drive. They are fast, efficient and require a minimum of horsepower. Also, steam jacketed cooker-mixers that reduce cooking time one-third, increase production and moisture absorption. All machines available for Immediate Shipment. For complete details and booklet, mail coupon below today.

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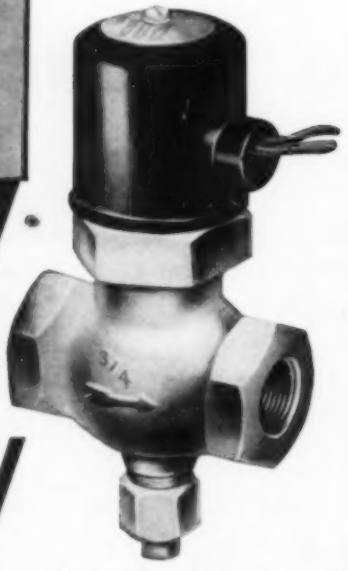
New **SINGLE SEATED VALVES**



- Unsurpassed refrigeration valves, specifically designed for the control of Freon, Sulphur-dioxide, Methyl-chloride—suction lines or hi-pressure liquid lines. Also air, water, gas, light oil, etc.
- These direct operated, single seated needle valves are held open electrically, thus eliminating unnecessary compressor burdens. Positive shut-off for fractional tonnage installations.
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Sherwin-Williams oil extraction unit

company's research staff. Processing is done in a single-stage operation instead of two stages, with a saving in processing time. In addition, according to A. W. Steudel, president of the company, the new process obtains more than 99 percent of all available oil from flaxseed, cocoa nuts, soya beans, castor beans, and other types of oil-bearing nuts, seeds and beans. Linseed oil produced by the process will not generally require filtration. In the past this was necessary if the oil was cloudy. It is claimed that the entire oil yield from castor beans will be top quality. The residue will be marketable for use in making glue, resins, emulsions, cloth, paper and similar products. It is ideal for fertilizer. Any castor oil above the needs of the company will be available for sale.

Chemical Society Holds Its Houston Regional Meeting

A RECORD crowd of 700 chemists and chemical engineers from eight states attended the third Southwest Regional meeting of the American Chemical Society held at the Rice Hotel in Houston December 12 and 13.

During the meeting several inspection trips were made. These consisted of inspections of the research facilities at Rice Institute, the new laboratories of Baylor University College of Medicine and the new exploration and production research center of Shell Oil Co.

Koppers Buys Resin Compounding Plant

Two companies have been purchased by the Koppers Co., Inc. The companies, Manufacturers Chemical Corp. and its sales subsidiary, the Chemaco Corp. of Berkeley Heights, N. J., it will be operated as wholly owned subsidiaries of Koppers.

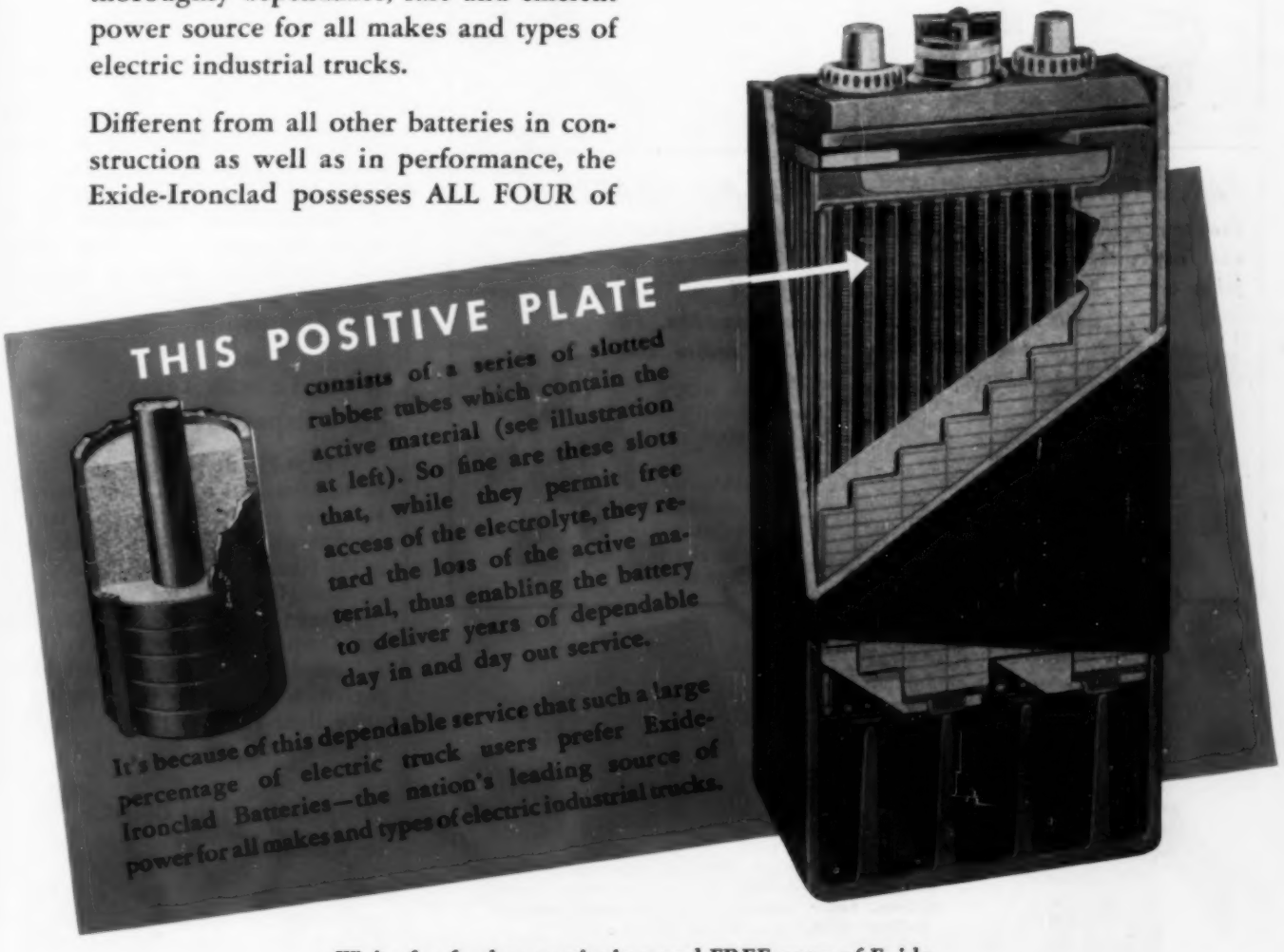
The new subsidiaries process and

USERS EXPRESS PREFERENCE FOR Exide IRONCLAD BATTERIES

IN a recent national survey made by a leading industrial publication, 81.1% of electric industrial truck users expressed a preference for Exide-Ironclad Batteries.

Such overwhelming preference for the Exide-Ironclad Battery is based upon user experience. This unique battery has, during the past 35 years, proved itself to be a thoroughly dependable, safe and efficient power source for all makes and types of electric industrial trucks.

Different from all other batteries in construction as well as in performance, the Exide-Ironclad possesses ALL FOUR of the essential characteristics demanded of a battery for electric industrial truck service—(1) high power ability, (2) high efficiency, (3) great ruggedness, and (4) long life. These characteristics are due to the special construction of the Exide-Ironclad Battery, especially its rugged, tubular positive plate.


THIS POSITIVE PLATE
consists of a series of slotted rubber tubes which contain the active material (see illustration at left). So fine are these slots that, while they permit free access of the electrolyte, they retard the loss of the active material, thus enabling the battery to deliver years of dependable day in and day out service.
It's because of this dependable service that such a large percentage of electric truck users prefer Exide-Ironclad Batteries—the nation's leading source of power for all makes and types of electric industrial trucks.

Write for further particulars and FREE copy of Exide-Ironclad Topics, which covers latest developments in material handling and shows actual case histories.

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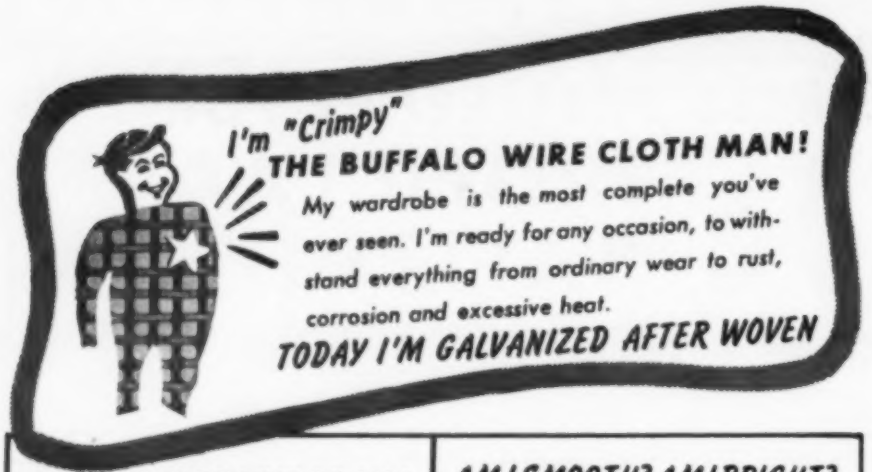
I'm "Crimpy"
THE BUFFALO WIRE CLOTH MAN!
My wardrobe is the most complete you've ever seen. I'm ready for any occasion, to withstand everything from ordinary wear to rust, corrosion and excessive heat.
TODAY I'M GALVANIZED AFTER WOVEN
COATED? EVERY BIT OF ME!
Know why? I'm hot dipt. But first I'm cleaned. Then, mind you, I'm pickled. Just try and work my coating loose!
AM I SMOOTH? AM I BRIGHT?
I'll say I am! I've just the right amount of zinc. Not too much. That would cause "points". Not too little. That would cause "pitting". Brother, I'm Controlled.
TAKE A LOOK AT MY NODES!
Ever see anything like them? Course not! They're sealed closed. Why, my joints are so smooth that one week I'm a tobacco apron and the next I'm a rayon conveyor.
LIKE MY SHAPE?
True and flat, isn't it? Stays that way, too! You don't see me buckling when I'm rolled out. Cut me into small pieces if you like. I'll still be square and rigid.
DON'T TAKE MY WORD FOR ALL THIS — Write my manufacturer for FREE FOLDER 597.
A valuable piece of literature about the unusual strength, firmness and wearing qualities; smooth surface, faster screening and accurate mesh of "Buffalo" Galv. After Woven Wire Cloth.
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sell compounds of polystyrene, cellulose acetate and ethyl cellulose. Purchase was made by an exchange of stock. Dan M. Rugg, vice-president and general manager of Koppers chemical division said that his division will operate the companies. All personnel will join Koppers.

New Research Services May Be Set Up in Arkansas

NON-PROFIT research services for industry may be established by the University of Arkansas following a discussion of the subject late in November in which industrialists and chambers of commerce representatives participated. Under a plan proposed by the Midwest Research Institute, Kansas City, Mo., the existing research facilities of the university would be coordinated by the University of Arkansas Research Foundation, a non-profit corporation established last summer.

ACS Forms New Local Group On Long Island

A NEW local group of the ACS, comprising chemists and chemical engineers of Brooklyn, Queens, and Long Island has been established according to Prof. Hans T. Clarke of Columbia University, chairman of the society's New York section with which the group is affiliated. The new unit will be known as the Metropolitan Long Island Group of the New York section.

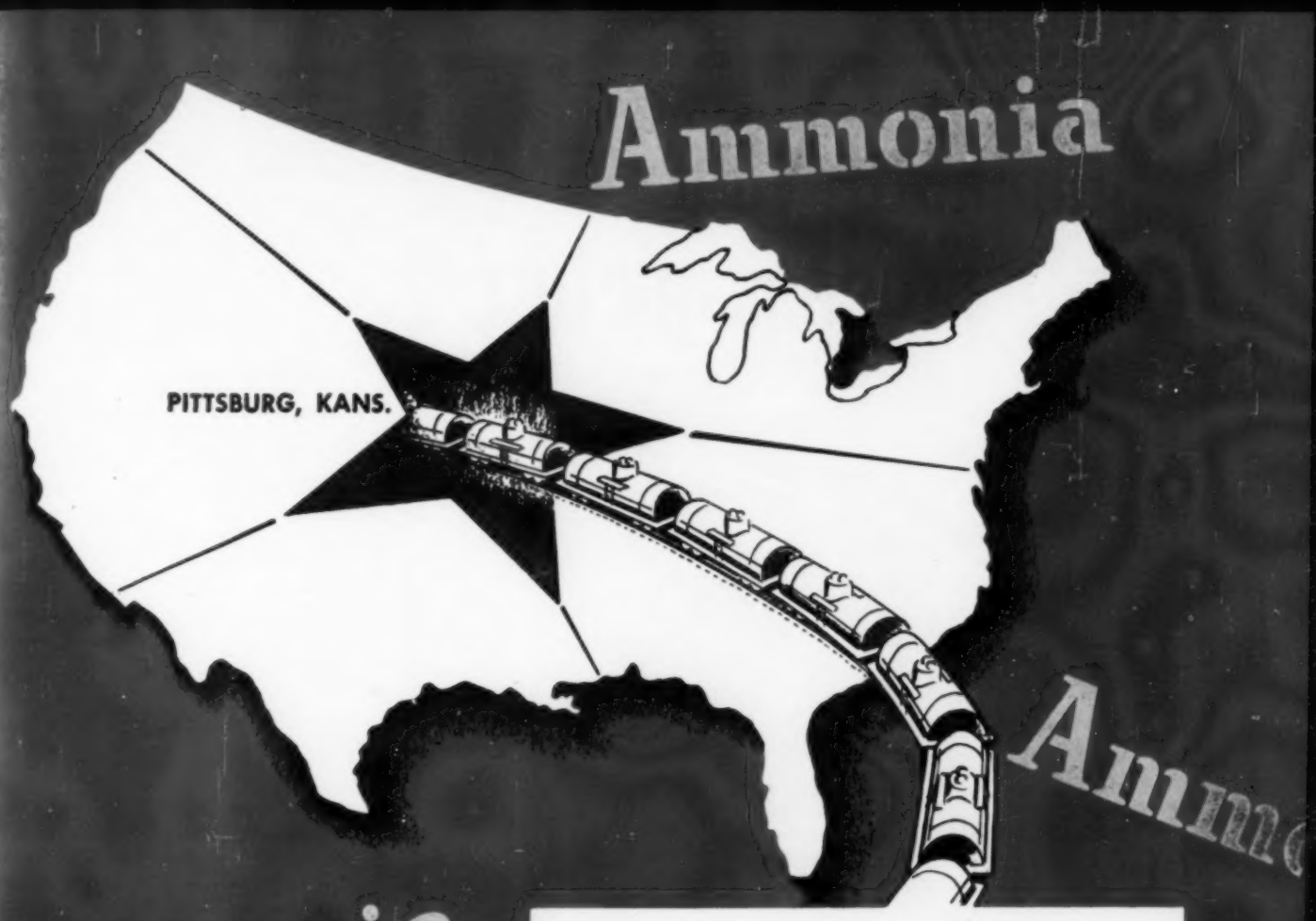
Witco To Start Texas Plant Expansion

WITCO HYDROCARBON CORP. plans to begin construction in January or February of a $3.5 million natural gasoline plant and carbon black plant in the Barnhart field in Reagan County, Tex. Contracts for the two plants have been awarded to Fish Engineering Corp. of Houston.

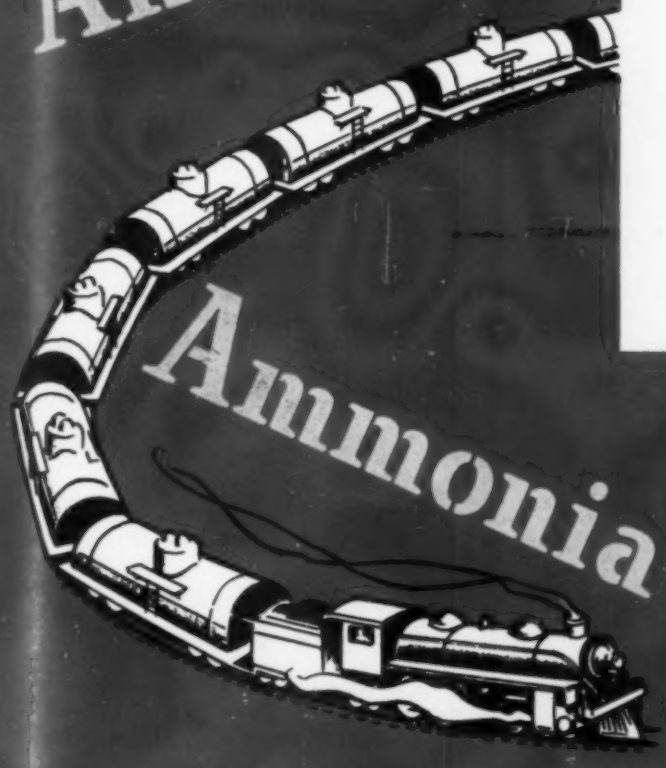
Completion of the projects is expected to terminate the flaring of more than 12 million cubic feet per day of natural gas in the field.

Symposium Held By ACS In Chicago

ADVANCES in heat control and their application to synthetic gasoline production were among the subjects discussed in Chicago at the Illinois Institute of Technology on December 29-30, before the 14th annual ACS chemical engineering symposium. Twenty technical papers were presented at the meeting, which was



Ammonia



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ANHYDROUS AMMONIA:
Commercial grade: 99.5% NH_3; maximum moisture content, .05%. Typical Analysis: 99.95% NH_3; .03% moisture; 2-3 ppm oil.

AQUA AMMONIA:
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EXPLORE the advantages of incorporating "Virginia" Liquid Sulfur Dioxide in your processes . . . as a reducing agent, reaction vehicle, acidification reagent, fumigant, selective solvent, bleaching agent, food preservative, refrigerant, dechlorinator for water purification. The possibilities of this versatile, uniformly pure reagent are rapidly being expanded into new fields of industry. Its use in *your* processes may result in definite product-improvement and savings of time, trouble, and money. Available by the cylinder, drum, or car.

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VIRGINIA *Chemicals*

WEST NORFOLK • NEW YORK • BOSTON • DETROIT

sponsored by the American Chemical Society's division of industrial and engineering chemistry. Dr. Bruce K. Brown, vice president of Standard Oil Co. (Indiana), spoke at a dinner meeting on Monday evening at the Morrison Hotel. Dr. Lincoln T. Work, Metal and Thermit Corp. was chairman of the symposium committee.

Commercial Solvents Elects Perry President

COMMERCIAL SOLVENTS CORP. elected officers at its November meeting. Theodore P. Walker was made chairman of the board and Henry E. Perry, formerly executive vice president was elected president of the corporation to fill the position left vacant by Major Walker's promotion. Major Walker will continue to participate actively in the management of the corporation.

Toluene Recovery Unit Moved To Texas City

PURCHASE by Petrol Terminal Corp. of toluene recovery equipment operated during the war by Magnolia Co. at Beaumont, Tex., has been announced by War Assets Administration. WAA says that Petrol will move the facilities to the aviation gasoline plant at Texas City formerly operated for the government by Southport Petroleum Co. Petrol has bought the plant.

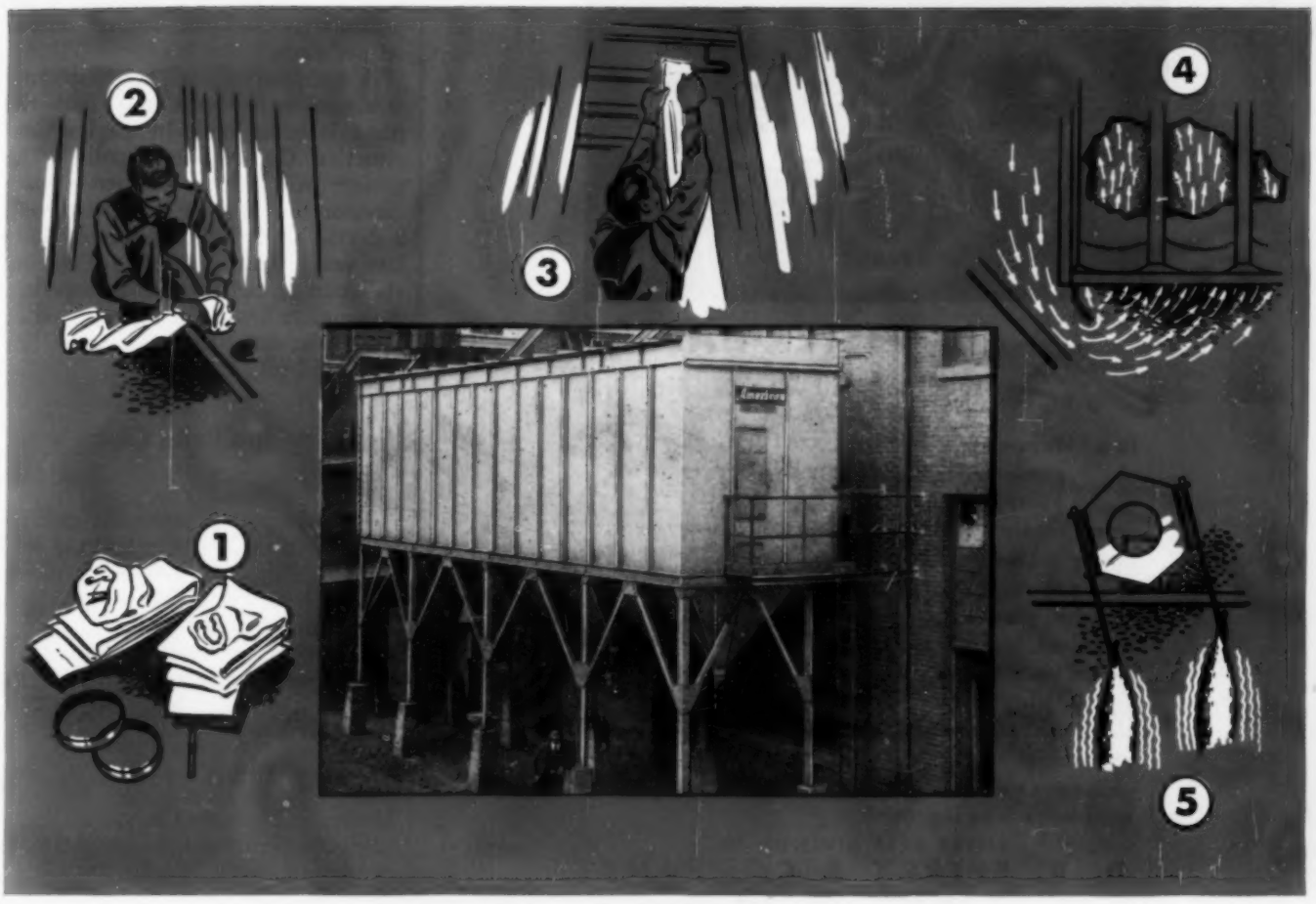
According to the WAA office at Houston, Petrol Terminal Corp. has bought the equipment at Beaumont in order to utilize portions for the erection of a 30,000 bbl. per day crude distillation unit.

Corn Products Texas Plant Construction Delayed

COMPLETION of the Corn Products Refining Co. Bluebonnet plant near Corpus Christi, Tex., is not expected until early 1949, an official declared late in November. The plant had been scheduled to be completed by next summer but construction has been unexpectedly slow. However, the company will be ready to buy next summer's sorghum grain crop.

Texas Flaxseed Plant Will Have Large Oil Output

FOLLOWING a brief notice in November of plans by the Archer-Daniels-Midland Co. Minneapolis to build a flaxseed processing plant at Kenedy, Tex., additional information confirms the fact that this will be a



Dustube keeps both your dust and your expenses under control

Certainly — dust is wasteful, dust is a breeder of high costs, dust is the enemy of efficiency. But — SO ARE HIGH MAINTENANCES AND OPERATING EXPENSES! So when it comes to buying dust collection equipment, be sure you get a machine that not only DOES ITS JOB WITH HIGH EFFICIENCY, but can be installed and operated at a MINIMUM of COST!

Such a machine is the American Dustube which gives *peak* performance (efficiency by weight; 98% and more) along with operation and maintenance that are consistently *low-cost.*

This means *more* than a method to rid your plant of dust. It means a machine carefully engineered to do a superb task of dust-removal, PLUS keeping your expenses down at all maintenance-points. It means cost-cutting economy of original installation. It means equal cost-cutting in the simplicity of daily operation. It *means a machine made to save you money.*

1. Tubes are compact, light, easy to store, economical to ship; they are never under tension . . . never in contact with metal which may abrade or corrode the fabric.
2. DUSTUBES are readily accessible from a central walkway. The economy of maintaining them is emphasized by the fact that ONE MAN only is required for quick, clean inspection or replacement. No Tools are needed.
3. Tubes are easily and quickly inserted or removed. Their condition can be seen at a glance. Only very fine float dust reaches these tubes, NEVER coarse cloth-wearing particles.
4. Extra-fine dusts (silica dust and others) are trapped with nearly 100% efficiency by weight. Discharged air shows less than 10 million particles per cubic foot from 2 to 10 microns in size.
5. Dust is completely removed from the filter tubes, which are shaken like a rug while deflated and limp. Result: lower operating resistance, longer cloth life, a direct saving in horsepower.

Write for Catalog 72

Containing valuable ventilation data, this 54-page illustrated book shows the full line of Dustube dust-collection equipment. It is yours on request.

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In a wide range of industries where filtration is a part of the process...sugar or shoe polish, for instance... Sperry Filter Bases have proved their efficiency.

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The ability to analyze your filtration problem and to furnish a filter base to meet your requirements is available at Sperry. Call on Sperry today. There's no obligation and there's a good chance your production efficiency will be improved.

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D. R. SPERRY & COMPANY
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"When I bought my Viking pumps, I knew they were engineered for my job. They were no off-the-shelf item that was supposed to do a little of everything and none too well.

"They were built for my work and to handle my particular problem. There was no guessing or compromising.

"My pumps today are several years old. They have needed little repairing. The newer Vikings are even better than mine although harder to get than when I bought them. They cost a little more but they are still an honestly good buy.

"Vikings are simple, rugged and well built. They always have been and I think they always will be. That's why I'm going to get more Vikings when I need more pumps.

"Your first step is to ask for free folder 475C. If you have a pumping problem, tell them about it."

See Our Catalog In SWEETS

Viking PUMP COMPANY
Cedar Falls, Iowa

large project having a capacity of approximately 100,000 lb. of linseed oil per day.

A company official says that construction has begun and that the plant is being built by Fegles Construction Co. of Minneapolis. The project will include a concrete grain elevator that will be connected with a drying plant built at Kenedy early last year. Plans provide for the installation of eight Anderson expellers. A complete linseed oil refinery will be erected in order to make a full line of linseed oil grades

New England Paint Club Elects Officers

ELECTION of officers was held at the November 20 meeting of the New England Paint and Production Club. Stuart White was elected president. Other officers elected were Robert Andrews, vice president; Arthur Anderson, secretary; and Charles Tannanbaum, treasurer.

Industry Briefs

Linde Air Products Co. is installing a $200,000 plant for the manufacture of oxygen and acetylene at Little Rock, Ark. It is believed that production will begin this spring. The five-acre plant site, purchased for $10,500 from Pulaski County, is on West 29th St. near Woodrow.

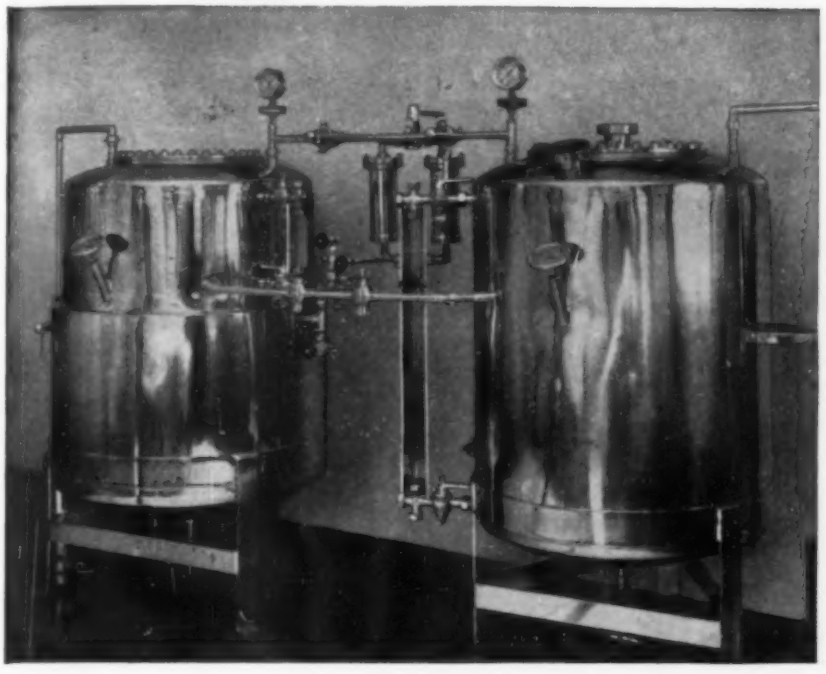
Air Reduction Co. is expanding its process engineering facilities at Stamford, Conn. The project staff, directed by C. J. McFarlin, will concentrate on improving the company's existing line of chemicals.

Materials handling machinery center has been set up by Yale & Towne Mfg. Co. at 205 East 43 St., New York, in the company's new materials handling machinery building. It plans to establish similar centers in other major cities.

Celanese Corp. of America has taken over all activities formerly conducted by various manufacturing and sales subsidiaries. Those affected include: Celanese Co. Inc.; Celanese Plastics Corp.; Celanese Chemical Corp.; Celanese Export Corp.; Tubize, Inc.; Staunton Textile Corp.; and Bridgewater Textile Corp.

Battery symposium sponsored by the Chicago Section of the Electrochemical Society in conjunction with the battery division of the society will be held at the Chicago Engineers' Club, 314 South Federal St. on February 7.

REPUBLIC *Enduro* STAINLESS STEEL



Protects Product Quality

Absolute sanitation is a "must" requirement in this pure yeast culture apparatus, made of lustrous, easy-to-clean Republic ENDURO Stainless Steel. Other ENDURO applications include autoclaves, condensers, heat exchangers, valves, kettles and tubing.

Cleanliness . . . sanitation . . . freedom from contamination . . . all three are vitally important in many different branches of the chemical process industries. That's why more and more processing equipment designers and buyers everywhere are specifying that their equipment be made of Republic ENDURO Stainless Steel.

ENDURO is inherently sanitary because it is a highly resistant material, has no effect upon quality or purity of most chemical and pharmaceutical products, and is not affected by them. Its smooth, pore-free surfaces offer no foothold for contaminating particles, and it is easy to clean and to keep clean.

For detailed information about these and the many other money-saving advantages of long-lasting ENDURO Stainless Steel, write today to:

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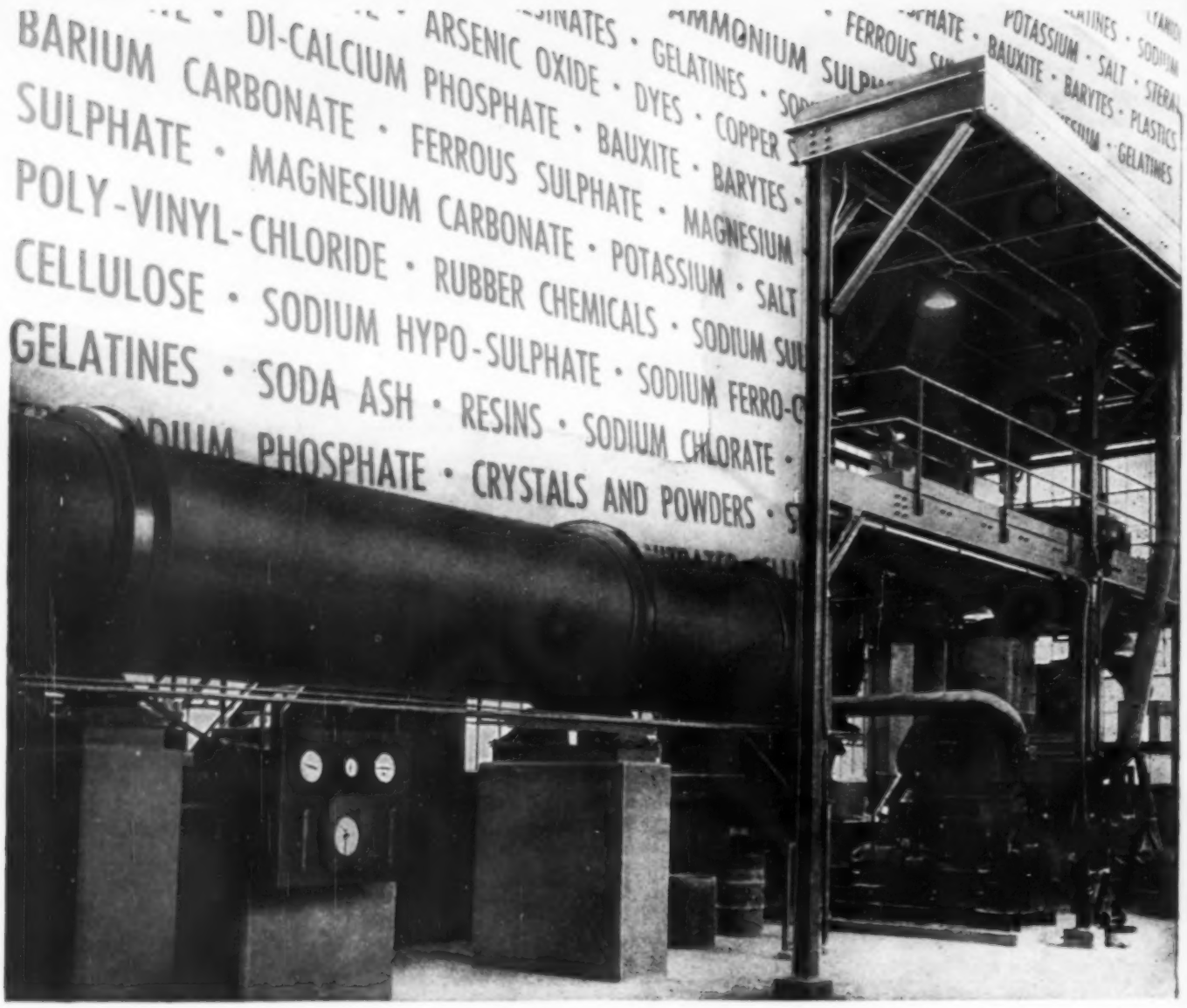
Other Republic Products include Carbon and Alloy Steels—Pipe, Sheets, Bolts and Nuts, Tin Plate, Tubing, Stevens Barrels and Drums



FOR EFFICIENT and PROFITABLE DRYING

The design and installation of dryers for use in the Chemical Industries call for the rigid adherence to exacting specifications, particularly in the handling of materials whose stability or other vital characteristics might be adversely affected by improper control.

A single example of the necessity for continuous control is the processing of pigments, where variations may result in serious impairment of color standards. Each chemical group has its own peculiar weak spot, which explains why so many manufacturers in the chemical field look to General American for the design and installation of their drying equipment.

Ask a General American engineer to assist in developing an installation which will keep you abreast of today's processing methods.

OTHER GENERAL AMERICAN EQUIPMENT

DEWATERERS
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EVAPORATORS
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CALCINERS
KILNS
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NEWS FROM ABROAD

Special Correspondence

Tasmania will use sulphur from zinc concentrates to make sulphate of ammonia if cheap power can be purchased . . . Argentine affiliate of Monsanto will build large chemical plant . . . Two Indian companies join in project to produce rayon-grade caustic soda . . . Russia to greatly expand production of vat dyes . . . France has ended price controls on many chemicals . . . British oil refiners given preference in expansion plans . . . Important bauxite deposit reported to have been found in Italy . . . Germany pushes output of soap

Tasmanian Company Will Make Ammonium Sulphate

ELECTROLYTIC ZINC CO. of Australasia Ltd. has decided to erect a $8,000,000 plant at its Risdon, Tasmania, zinc refinery to produce 50,000 tons of ammonium sulphate annually from the sulphur constituent of zinc concentrates and from synthetic ammonia. The decision is contingent on successful negotiations for the purchase of cheap hydro power, which abounds in Tasmania, and on authorization to import some items of equipment from the United States. The $8,000,000 estimate covers plant units to produce hydrogen, nitrogen, ammonia, sulphuric acid and sulphate of ammonia.

Sir Walter Massy-Greene, Electrolytic Zinc chairman, believes that production cost will be much lower than for fertilizer produced from by-product ammonia and sulphuric acid derived from imported elemental sulphur. At present, about 50 percent of Australia's demand for ammonia is supplied by gas works. Plans to convert four wartime nitrogen fixation plants to fertilizer production have made little headway. One plant is operating at a fraction of its rated capacity of 12,000 tons of ammonium sulphate a year. The others are producing small quantities of methanol and formalin.

Although part of the zinc concentrate from Broken Hill and from the Read-Roseberry field is used in sulphuric acid production, most of the sulphur in zinc concentrates is either lost to the atmosphere in roasting or exported with the metal constituent. Australia imported more than 100,000 tons of elemental sulphur annually before the war and has been approaching that figure again since the war.

During the war, the amount of zinc concentrate used in acid manufacture at first declined and then increased, but not to any great extent. Australia has been consistently exporting a greater sulphur equivalent in zinc concentrates than she has been importing as elemental sulphur. Self-efficiency in sulphur is therefore possible and has become desirable in view of the dollar shortage.

Monsanto Affiliate Will Build Argentine Plant

CONSTRUCTION of a $100,000,000, two-unit project for manufacture of industrial chemical products, pharmaceutical supplies and plastic items, will be undertaken by Montesanto-Atanor, Industrias Quimicas Argentinas. Plans for the new installation have been approved. The firm is a combination of the North American firm, Monsanto, with an Argentine mixed capital company, Atanor.

Rayon Grade Caustic Will Be Produced in India

ESTABLISHMENT of a partnership between Mettur Chemical & Industrial Corp. and Fertilizers & Chemicals Travancore Ltd. to erect and operate a 20-ton-a-day plant in India to produce rayon grade caustic soda has been announced by Mettur officials. The new plant will be constructed at Alwaye in Travancore, site of the FACT 50,000-ton ammonium sulphate plant.

The project is part of a joint plan which aims at eventually supplying all of South Indian's needs for caustic soda. Mettur is to triple its own 2,300-ton-a-year capacity and already has placed orders abroad for equipment which by the end of 1949 will make it an economic and efficient unit.

Seshasayee Bros. Ltd. are managing agents for both Mettur and FACT. It is this firm's estimate that early next year arrangements will be completed for the acquisition of additional capital to cover the expansion which is expected to total more than $2,000,000.

Russia Will Increase Output of Dyes

AIMING to produce the world's best cloth, the Soviet textile industry demands better dyes from the country's chemical industry now elaborating a broad recovery program for aniline dye production. The program is scheduled for completion by 1950, when almost all dye needs of the Soviet textile industry are expected to be met by home production. Urgently in need of dyes, the textile industry demands completion by 1948 of a "minimum" program assuring dye output in every base color.

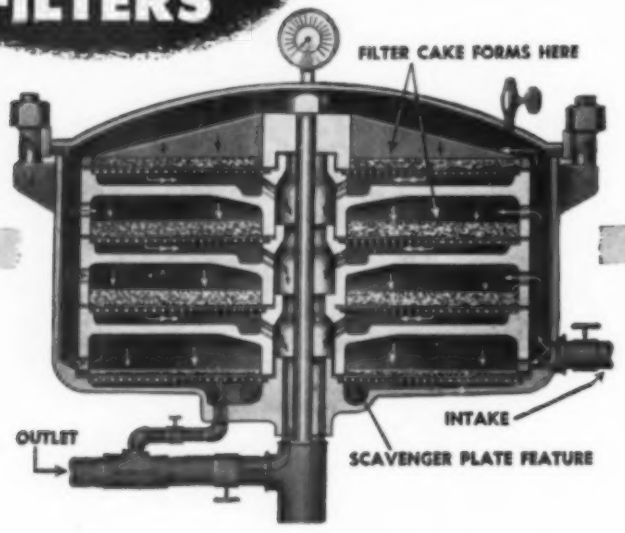
Under the restoration program, as visualized by Soviet textile experts, production of vat or indigo dyes must be increased six to eight times above prewar levels at the expense of less durable adjective dyes. In 1938 only 0.2 percent of the dyes utilized in the Soviet cotton cloth industry were the fast bright indigo dyes, whereas 89 percent were the less color-fast and duller sulphide dyes. In the postwar period the specific weight of sulphide dyes is to be gradually reduced, while quality is to be improved.

South African Plant To Get Oil from Coal

UNITED STATES technical know-how advice will be followed at the oil-from-coal plant to be erected at Vereenig-

Last Drop filtration of chemicals with

SPARKLER
Horizontal Plate
FILTERS



. . . . . any liquid from heavy varnishes to light alcohols

The horizontal plate principle of filtering chemicals provides complete flexibility and uniform dependable results. When diatomaceous filter aid is used it forms a pure silica sieve of uniform microsize mesh. Other filter media form a similar firm filter cake on the Sparkler horizontal plates. Flow is always with gravity. The horizontal position of the built-up cake prevents slipping or cracking either with continuous or intermittent flow.

Available in two plate depths, Sparkler construction provides deep plates for liquids carrying a large proportion of solids. Sparkler shallow plates for use on liquids carrying only a small proportion of solids provide a larger filtering area within the same size tank.

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ing, South Africa, by the Anglo-Transvaal Consolidated Investment Co. Within three years it will produce 60,000,000 gal. of gasoline and 9,000,000 gal. of diesel oil.

According to A. S. Hersov, chairman of Anglo-Vaal, who recently returned from the United States and the United Kingdom, the plant will be a replica of the Standard Oil of Indiana plant at Hugoton, and will incorporate improvements to the plant at Brownsville. Technical advice will come from Hydrocarbon Research, Inc. of America.

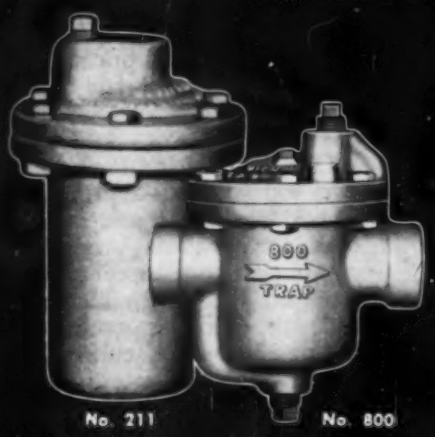
The newest techniques as reported to the American Institute of Chemical Engineers use a new type of catalyst. The starting point will be coal, which will be converted into synthesis gases of substantially the same quality as are derived from methane. From then on the process will be identical with the American process. The plant, which will cost about £14,000,000 is being constructed.

South Africa has been producing oil from torbanite for some years, and its experience should be valuable to the Vereeniging undertaking. Licenses to produce oil from coal will be issued by the Minister of Economic Development on the advice of the Liquid Fuel and Oil Industry Advisory Board.

France Frees Chemicals From Price Controls

FRENCH government is finally on the way to abandoning the tremendously complex system of price fixing and rationing which has been imposed on the chemical industry since early in the war. Implementing the new government policy Jules Moch, Minister for Economic Affairs, announced in November that rationing and price control would be ended on 473 products, including 182 chemical products such as galalite, celluloid, and collodions. Nylon and asphaltic products were also freed. In one swoop this order has freed a third of the products formerly controlled. Superphosphates and potash fertilizers (except potassium sulphate and potassium nitrate), and also copper sulphate, were freed last June.

These government actions seem likely to allow higher prices for a considerable number of products, though a few items are reported to have been sold already at prices under the maxima fixed by the government. Further pressure on prices will come from current demands by the General Confederation of Labor that wages be raised throughout France by 15 to 20 percent, and that minimum wages



No. 211 No. 800

Above left — Armstrong bottom inlet—top outlet series trap.

Above right — Armstrong No. 800 side inlet—side outlet trap.

PROOF THAT ARMSTRONG TRAPS PAY DIVIDENDS:

½ TON COAL SAVED daily at American Snuff Co., Clarksville, Tenn., with 12 No. 813 traps on tobacco drying kiln. Also ½ hour faster heating up.

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15% FUEL SAVING, 62% less maintenance with Armstrong Traps at Grove City Floral Co., Grove City, Pa.

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20% LESS fuel consumption, 65% LESS water consumption, and more extraction of oil from material being crushed, after use of Armstrong traps.—Pacific Nut Oil Company, Los Angeles.

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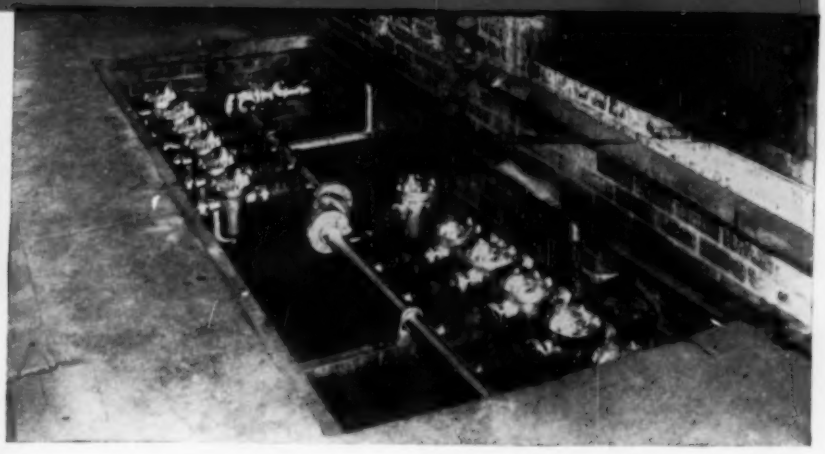
ONE BOILER INSTEAD OF TWO used after installing Armstrong traps. Also 30-ton-per-month saving in fuel.—Daniel Bassi and Co., Buenos Aires, Argentina.

For Fuel Savings and Maximum Production

SELECT THE CORRECT STEAM TRAP FOR THE JOB!



In order to maintain high temperatures, high production and minimum fuel consumption it is essential that steam traps be correctly selected for each piece of equipment in your plant. Don't select traps by pipe sizes alone. Here's a convenient check list for proper trap selection:*

1. DOES THE TRAP HAVE ADEQUATE CAPACITY FOR PEAK LOADS? Traps should have the capacity to take care of the above normal condensate loads encountered in starting up cold equipment. This will often save hours of warming-up time and greatly increase production.

2. DOES THE TRAP *ACTUALLY* HAVE THE CAPACITY CLAIMED FOR IT? It is possible to unknowingly buy a trap with insufficient capacity. This limits production and wastes fuel. Armstrong trap capacities are very conservatively based on *actual* tests with hot condensate, and a liberal safety factor is recommended. If you follow Armstrong recommendations the traps will handle any condensate load that will be encountered.

3. IS THE TRAP SUITABLE FOR THE PRESSURE? A trap won't work satisfactorily at a steam pressure above that for which it is designed. (In switching traps from one location to another, be sure they are not put on a line with a pressure above their rating.)

4. DOES THE TRAP HAVE ADEQUATE AIR-HANDLING CAPACITY? Air (always present in steam) reduces heat transfer efficiency, lowers temperatures and slows up production. Armstrong traps discharge all normal amounts of air along with condensate.

5. DOES THE BODY STYLE PERMIT THE MOST EFFICIENT INSTALLATION? Correct installation, essential to efficient trap performance, is simplified and reduced in cost by the choice of Armstrong trap body styles: No. 800 Series side inlet—side outlet; No. 801 Series side inlet—bottom outlet, and No. 200 Series bottom inlet—top outlet.

*The 36-page ARMSTRONG STEAM TRAP BOOK gives complete data on trap selection and installation on all classes of equipment. Send for your copy. ARMSTRONG MACHINE WORKS, 858 Maple Street, Three Rivers, Mich.

ARMSTRONG *Inverted Bucket* STEAM TRAPS

No. 2 of a series of advertisements devoted to improving efficiency through better trapping.

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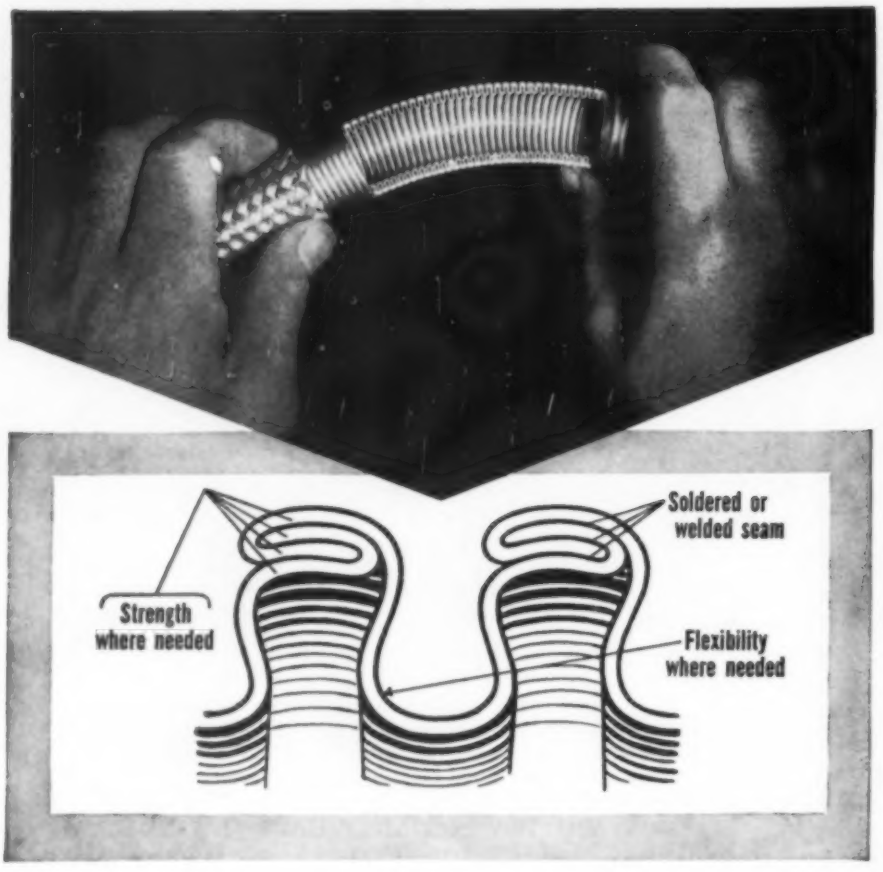
Titeflex stands up



The drawing above illustrates exactly why Titeflex all-metal flexible tubing stands up under the most rugged conditions.

Note that there are *four* thicknesses of metal at the top of each convolution—right where the greatest wear is encountered.

Note that flexibility is achieved by wall construction without deforming or stretching the metal. There are no packed, sliding joints to wear out or decompose.

Note that the metal strips are soldered tightly together to prevent leakage of both gases and liquids.

Note that Titeflex tubing is *all metal*—it is unaffected by gas, oil or liquids . . . and withstands high temperatures. Yet it is fully flexible and holds up under excessive vibrations.

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be increased over 50 percent. Costs also are being pushed up by a 60 percent increase in coal prices introduced early in November, and the higher freight and power rates sure to follow this increase.

One result of the stepped-up price level will be to make exports increasingly difficult. A considerable decline in exports has already been noted. The government hopes to control inflation, however, after a new higher level of industrial prices is reached, by balancing the budget, cutting down on credit, and preventing agricultural prices from rising above their present level.

Power Cuts

Meanwhile the chemical industry is threatened with even more severe power cuts than last winter. During most of last winter, and so far this fall, most of French industry was able to operate only four days a week because of the power shortage. The annual report of Etablissments Kuhlmann for 1946 points out the supply conditions then, very similar to those today. Certain essential supplies such as pyrites, crude phosphate, salt, soda and copper, were received in sufficient quantities, but others, especially coal, coke and electric energy, were in deficit.

Kuhlmann has now practically completed reconstruction of its badly damaged Dieuze plant. Nearly all the company's sulphuric acid equipment is in working order. At Dieuze all the shops for making barium products are functioning. The Paimboeuf plant, begun in 1940, has finally begun operations. It began making methanol in 1946, though the first units for making synthetic ammonia and ammonium sulphate there will not be ready for operation until sometime this year.

Nominal Capital Value

Many French chemical companies, including some affiliates of Kuhlmann, have increased the nominal value of their capital over the past 18 months, often by issuing new shares to present stockholders. Reason for such moves is the ever-increasing inflation, which had made the book value of capital insignificant in terms of companies' real net worth.

French manufacturers of pharmaceuticals have managed to pull their output up to about 120 percent of prewar levels on the average, aided by generous allocations of raw materials. But this average conceals severe shortages of a number of products based on imported raw materials such as ephedrine, essential oils, opium, many

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biologicals, glands, cholesterols, etc. The price-cost ratio also is increasingly unfavorable. Pharmaceutical prices now average about 3.3 times the 1939 level, while the average of wages in the industry is between seven and eight times the prewar level. And the government is unlikely to set prices free in this field because, owing to social security laws which provide reimbursement from the State to individuals buying drugs, the government is now indirectly almost the sole purchaser.

Before the war France was a very important exporter of pharmaceuticals, but this trade has been hurt greatly from having been cut off during the war and from the inability of French manufacturers to present their products as well as can the Americans, owing to shortages of high-quality paper, cellophane, etc. Export trade is still important, however, to such countries as Belgium, Switzerland, Greece and the Middle East, and to a lesser extent South America. A large trade also continues with the French colonies. Figures for the first half of 1947, for brand-name goods only, were: Foreign: $4,630,000; Colonies: $7,000,000.

Imports since the war, aside from raw products, have been concentrated especially on such new drugs as penicillin and streptomycin. Imports in 1946 totaled about $40 million. During the first half of 1947 they were down by around half, to about $10 million, and of this $4 million came from the U. S., with $2 mllion representing penicillin alone.

At present the French dollar shortage has forced the government to cancel all pharmaceutical imports from dollar countries, and although U. S. aid is likely to cause a partial lifting of this embargo the volume of imports from there seems unlikely to regain former levels. Penicillin for example is now being produced by two new factories in France, which already supply most of the country's needs.

India Designs Portable Hydrogen Generator

A PORTABLE apparatus for generating hydrogen has been designed by the Meteorological Department of India in its observatory laboratory in New Delhi. Through this development, hydrogen is made available at mobile observatory stations for pilot-balloon observations.

The generator uses the silicon-soda process in making the hydrogen. The ferrosilicon is dropped into a solution of hot caustic soda, care being taken to keep enough solution in the generator to produce the required quan-

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CALCINED ALUMINAS	Al_2O_3 Calcined to various degrees resulting in a wide variety of characteristics. Current uses: Abrasives, ceramics, glass, porcelains, refractories, electrical insulators, ferrous-metal fluxes.
LOW SODA ALUMINAS	Al_2O_3 (With less than 0.15% Na_2O). Two grades provide low and normal shrinkage characteristics. Current uses: High-grade electrical insulators and other ceramic bodies.
TABULAR ALUMINAS	Al_2O_3 (Alpha Alumina). Available as fine powder, coarse granules and dense balls. Residual moisture: 0%. Soda content as low as 0.05%. Extremely low shrinkage. Current uses: High quality electrical insulators, high temperature refractories, catalysts and catalyst supports, and heat-transfer operations.
HYDRATED ALUMINAS	$Al_2O_3 \cdot 3H_2O$ (Typical compound). Fine white crystalline powders, more reactive than calcined aluminas. Current uses: *Series C-30 grades*—chemicals, catalysts, ceramics, glass and water softeners. *Series C-700 grades* (average particle size: 0.5 micron)—rubber and plastic compounding, cosmetics, pigments and fillers.
ALUMINUM FLUORIDE	AlF_3 (Anhydrous). White crystalline solid, chemically inactive at room temperature. Current uses: Non-ferrous metal fluxing and constituent of ceramic-body and glaze mixes.
SODIUM FLUORIDE	NaF A fine, white crystalline powder, light and fluffy with good dusting properties. Current uses: Ingredient of insect powders and rat poisons, constituent of vitreous enamel and glass mixes, and a steel de-gassing agent.
SODIUM ACID FLUORIDE	$NaF \cdot HF$ A free-flowing, white crystalline powder. Does not cake under normal storage conditions. Readily soluble in hot or cold water. Current use: Laundry sour for rust removal and for neutralizing last traces of alkali in rinsing operations.
FLUOBORIC ACID	HBF_4 E. B. concentrate—a specially purified solution of fluoboric acid. Principal current use: Electrolytic Brightening of aluminum. (Patented process.)
CRYOLITE	Na_3AlF_6 Produced chemically by precipitation resulting in a product of highly uniform particle size (average: 2 microns).
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EXPANSION PLANS FOR BRITISH REFINERIES INCLUDE FACILITIES FOR PETROLEUM CHEMICALS

More coal and raw materials are reaching British chemicals makers, especially for export work, but further substantial output gains depend on new plant being brought into operation. From the government's White Paper on Capital Investment in 1948, however, it appears that a further slowing-down of factory construction must be anticipated. In industry generally steel allocations for building will be cut substantially; no new industrial buildings or extensions will be started for at least six months, except a limited number of projects of exceptional importance for exports or import saving; and of factory building now in progress which has not yet reached the steel erection stage at least half will be postponed.

As chemicals makers got away to an early start in postwar expansion, quite a few of their schemes, though held up by delivery delays, are beyond that stage and will not be affected by official restrictions on capital expenditure. Many early extensions came into production in 1947 or will be ready early in 1948. Expansion schemes in a less advanced stage, however, will suffer all the more severely. For some time chemical interests have tried to convince the government of the key position held by chemicals in the industrial economy and the need for more plant. It is agreed that the higher export targets and essential home needs cannot be met at the same time by output from existing plant. The industry thus hopes for lenient treatment when factory construction licenses are reviewed, but it can hardly expect to go scot-free when so many other trades can present equally strong cases for priority.

There is, however, one branch of the chemical industry which has been granted preferential treatment for a vast expansion scheme. Extensive plans for increasing oil refining capacity in Britain have been approved in principle. Programs of plant deliveries and building labor requirements are not sufficiently advanced to

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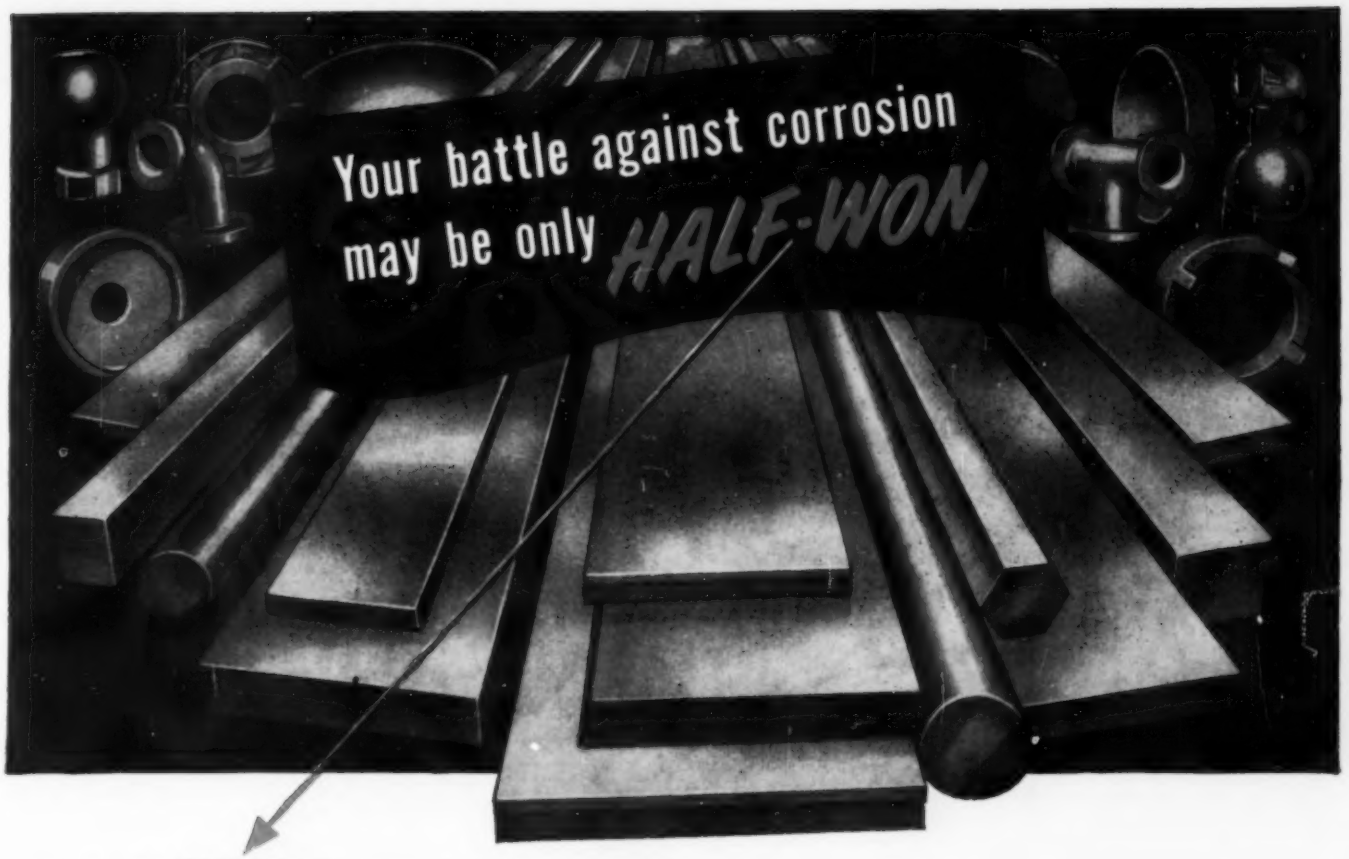

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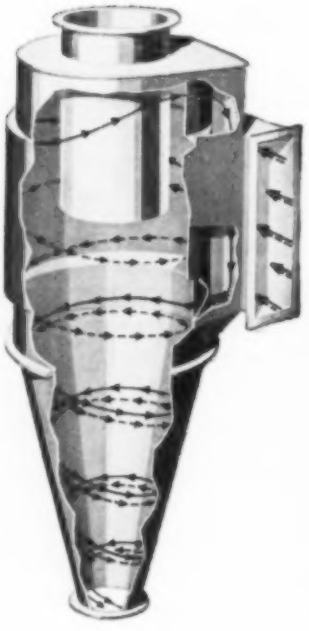
Dust Recovery



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is to get down to fundamentals. What equipment will collect dust particles in the sizes that count, with an efficiency you can count on, and at the most practical cost. . . . For economy, a system's got to be simple — without moving parts or need for maintenance. That means a Buell van Tongeren Cyclone, if you really want to trap the low-micron fines, too. Only the van Tongeren has the Shave-off, to put it in the high efficiency class. A Buell catalog makes this all plain. Write for one, its "brass tacks" approach makes it easy to read.

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permit the final allocation of a labor force but 4,800 building operatives have provisionally been earmarked for work on refineries about the middle of the year. Total amount of £95,000,000 is to be spent on the erection of refinery capacity sufficient to handle 20,000,000 long tons of crude oil a year, and of this no less than £60,000,000 will be for plant of all kinds.

Extension program of the Agwi Petroleum Corp. has advanced farthest. The company received approval to go ahead with construction work at Fawley, on the banks of Southampton Water, designed to increase its refinery from 600,000 tons a year to over 3,000,000 tons.

On an even bigger scale is the plan of the Royal Dutch-Shell combine to build two new refineries, one at the Thames estuary, not far from London, and the other one on the Manchester Ship Canal, near the Lancashire textile region. The combine intends to spend over £40,000,000 on new refineries in various parts of the world, and it is believed the major portion of this sum may be spent on the two English refineries and ancillary plant for them.

New Refinery

The Anglo-Iranian Oil Co. has plans for erection of a new refinery at Grangemouth, Scotland, likely to cost £7,000,000. Smaller projects announced are those of the Manchester Oil Refinery in Lancashire and the Trent Oil Products Ltd. in Northumberland. Together with existing refineries and smaller schemes which may yet be announced by other companies with a stake in the British market, these projects will provide refining capacity sufficient to meet all demands of the large home market and leave substantial quantities of various fractions for export.

Significance of this development from the chemical point of view can hardly be exaggerated. Several of the new refineries are closely linked with schemes for production of petroleum chemicals. The Grangemouth refinery will provide raw materials for the Anglo-Iranian/Distillers chemical plant, plans for which were announced some months ago. This project, it has been stated since, will not be postponed as a result of the government cuts of capital expenditure. The new Shell refinery on the Manchester Ship Canal will supply raw materials for the chemicals plant now in course of erection in this locality. Manchester Oil Refinery plans are also known to be connected with chemical production. While the Grangemouth chemical plant was originally intended to

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Here is another example of the results you can get when you put Carpenter's experience with Stainless Tubing to work in your plant.

These Van Stone flanges were done cold, with the flanges rolled-out from the tube wall. Expansion is uniform throughout the flanged area. The corner at the back of each flange is sharp—with no weakening of the metal's ...ure.

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SLIDE CHART DATA ON STAINLESS TUBING

This Carpenter Stainless Tubing Slide Chart provides information that has never before been available in such easy-to-use form. It contains data on Velocity Constants, Mass Velocity Constants, Areas of Tube, Physical Properties, etc. For your copy, just send us a note on your company letterhead.

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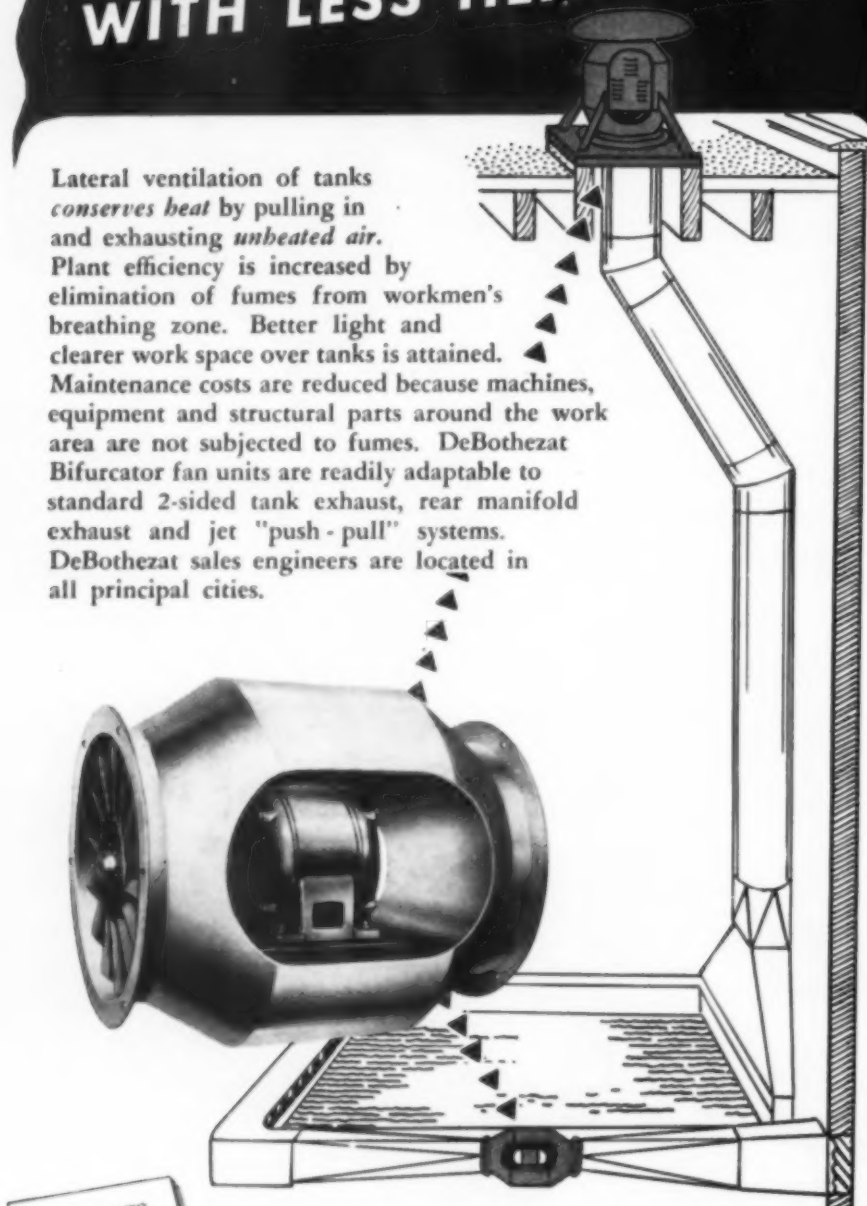
"MORE THAN CORROSION RESISTANCE"

Ventilate Tanks Laterally to REMOVE FUMES WITH LESS HEAT LOSS

Lateral ventilation of tanks *conserves heat* by pulling in and exhausting *unheated air.* Plant efficiency is increased by elimination of fumes from workmen's breathing zone. Better light and clearer work space over tanks is attained. Maintenance costs are reduced because machines, equipment and structural parts around the work area are not subjected to fumes. DeBothezat Bifurcator fan units are readily adaptable to standard 2-sided tank exhaust, rear manifold exhaust and jet "push - pull" systems. DeBothezat sales engineers are located in all principal cities.



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provide Distillers Co. with an alternative source of industrial alcohol for its solvents and plastics departments and the Shell chemical plant will attach special importance to the manufacture of soapless detergents, neither of these two plants will be confined to these products.

Advantage which treatment of crude oils in the British Isles offers for the establishment of a petroleum chemicals industry was one of the major considerations which caused the government to assent to the investment of large amounts of scarce machinery and building materials in new oil refineries. There is reason to believe that chemical plants will operate in conjunction with the new refineries at Fawley and near London as well as with those near Manchester and at Grangemouth. Construction work on the chemical plants will receive the same degree of priority as work on the petroleum refineries themselves.

Another branch of chemical interest which features prominently in the government's capital expenditure program is the gas industry. No less than £21,400,000 is to be spent this year on new plant and reconstruction of old plant, and £23,600,000 has been earmarked for this purpose for 1949. Iron and steel industry's modernization and extension program, which was drawn up in 1945, will be reviewed shortly. It involves substantial expenditure on coke-ovens and byproduct plant. British gasworks are also keen on byproduct recovery in the interest of operational efficiency and economy.

Such large amounts of new plant and apparatus will be needed for refineries and coal distillation works that the British equipment industry will be hard put to meet all needs even if part is obtained abroad. In the first nine months of 1947 orders for over £33,500,000 of oil refinery equipment were placed for British-owned refineries, nearly four-fifths of it for use overseas. In view of the progress made with rehabilitation of damaged oil plant in the East it may be thought that more British refinery equipment will in future be available for installation at home. Special arrangements for standardization and interchangeability will help, and close collaboration is to be sought with U. S. oil engineering companies.

New Petrolum Refinery For Mexican Company

CONTRACT has been awarded for the design, engineering, purchasing and construction of a complete new petroleum refinery for Petroleos Mexicanos at Salamance, Mexico. It will cost about $12 million and will consist

IF YOU'RE SEEKING SAVINGS

in *CONSTRUCTION* and *MAINTENANCE*

here's the place to look!

If rocketing construction costs have brought you budget problems, let Koppers pressure-treated wood solve them. In applications from foundations to roof decks, it brings *present savings* in building costs—*future savings* through long, trouble-free life and low maintenance.

PERMANENT FOUNDATION WORK. Koppers pressure-creosoted piles provide high load-bearing capacity at low cost. Preservative treatment permits cut-offs to be safely made above water table.

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● The Bowen Laboratory unit is designed to provide information which can be directly applied to the development of new products and processes. It is built under the same general designs as the large commercial Bowen engineered Spray Dryers. Factual information on request.
BOWEN ENGINEERING, INC.
Garwood 1, New Jersey
BOWEN

of a 30,000 bbl. crude distillation unit, gas oil thermal cracking unit, electric power generation plant, ethyl blending equipment, and other facilities needed for a modern refinery. The contract is held by Arthur G. McKee Co., Cleveland, who will begin actual construction in 1948 with the project scheduled to be completed some time in 1949.

New Source of Bauxite Discovered in Italy

In a recent report to the Supreme Mining Committee, Italian Premier de Gasperi disclosed that a new source of bauxite has been discovered in the Gargano peninsula, southern Italy. He estimated that it would yield 30 million tons. Premier de Gasperi also reported that an important zinc formation has been discovered on Sardinia near Monteponi. Surveys, he said, were recently carried out by the Italian Mining Engineering Corp.

German Plants To Produce Raw Materials for Soap

The Rheinpreussen chemical works at Hamburg, in the British Zone of Germany, will begin production of raw materials needed for the soap industry in western Germany. One-third of the plant's capacity will be used for this purpose. The former I. G. Farben establishment at Krefeld will manufacture raw materials for similar use at Urdingen, where methanol for the plastics and pharmaceutical industries also will be produced.

Foreign News Briefs

Potash exports from Palestine have been increasing in volume and amounted to 71,276 metric tons in the first half of 1947 as compared with 39,376 metric tons in the like 1946 period.

Mineral resources in Spanish West Africa, including ochers, phosphate rock, pyrites, and sulphur have been reserved to the Spanish State. This conforms with the government policy of controlling exploitation of resources important to the national economy.

Universities in the United Kingdom in conjunction with the Scottish Seaweed Research Association are investigating the potentialities of seaweed as a fertilizer and for other uses.

Only sulphur mines in operation in the Dodecanese Islands are at Nisiro and produce from 1,000 to 3,000 tons a year. The average sulphur content is 35 percent.

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in designing and building equipment and complete plants for the resin industry.

We specialize in this wide field, including equipment for resin production, varnish cooking, oil bodying, molding powder production and similar operations. Blaw-Knox covers the equipment needs of this field thoroughly, including design and construction of complete plants.

Our new publication "Blaw-Knox Resin Plants and Equipment" tells you about a number of actual installations and includes preliminary design questionnaires to help you get further information.

Ask for Bulletin No. 2087, on "Blaw-Knox Resin Plants and Equipment"

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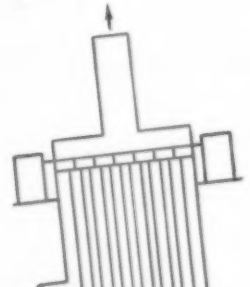
and Equipment

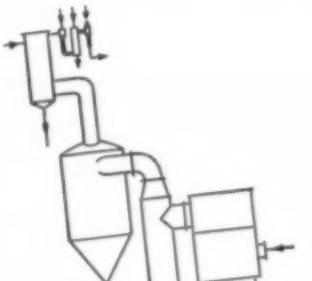
STOP H_2SO_4 COLD!

with Carbon . . . Graphite . . . and "KARBATE" Impervious Graphite!

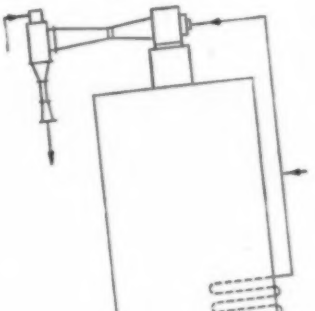
● "National" Carbon, Graphite, and "Karbate" Impervious Graphite are the most efficient materials for handling sulphuric acid. Equipment made of these materials is resistant to chemical attack by sulphuric acid up to 96% concentration. Moreover, it is light in weight, machinable, and mechanically strong. It is resistant to thermal and mechanical shock. There is no metallic contamination of the product. Both Graphite and "Karbate" Impervious Graphite have the highest heat-transfer rate of any practical material used in handling corrosive substances.



Electrostatic Precipitators for Acid Mists — All corrosion eliminated with **carbon** housing, stack, tubes, beams, and grillage.

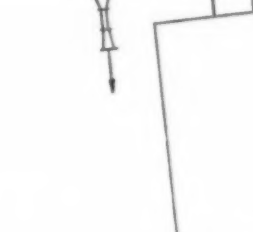


Spin-Bath Evaporators — Improved heat-transfer rates and no metallic contamination with **"Karbate" Impervious Graphite** heating elements and auxiliary parts.



Acid Concentrators — Spalling problems solved with carbon-lined bodies. Vapor piping, steam ejectors, and barometric condensers protected from erosion and corrosion by **carbon or graphite** linings.

Acid-Dilution Equipment — 66 deg. Be. H_2SO_4 "cut" to any lower concentration quickly and economically with **"Karbate" Impervious Graphite** mixers, coolers, pumps, pipe, fittings, and valves.



Plating-Solution Heat Exchangers — No metallic contamination with high-heat-transfer, corrosion-resistant **"Karbate" Impervious Graphite** exchangers.

The terms "National" and "Karbate" are registered trade-marks of

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Sodium Chloride Versus Construction Materials

Fourth and final part of a symposium in which typical materials of construction are evaluated for services involving sodium chloride

CHEMICAL STONEWARE

F. E. HERSTEIN
General Ceramics and Steatite Corp.
Keasbey, N. J.

CHEMICAL stoneware is, of course, impervious to the action of sodium chloride, both dry and in solution, and at all concentrations and temperatures at which this material is handled and processed. Chemical stoneware piping and pumps can be used for handling brine solutions and at least one installation of stoneware for handling chlorinated brine from chlorine cells is known. An interesting application, where absolutely no iron contamination is allowable, is in the pumping of sea water to aquariums. Several applications of this type are contemplated at the present time. It may be said in summation that although chemical stoneware is admirably suited for the handling of sodium chloride brines, it is not widely used because other equipment is more readily available and in some cases more economical. Thus chemical stoneware is reserved for the stringent applications which no other equipment will bear.

HAVEG

E. P. MAMPE
Haveg Corporation
Newark, Del.

HAVEG equipment is completely resistant to chemical attack from sodium chloride in all concentrations and within the temperature limitations which have been established for this plastic material.

Aeration of brine solutions or the presence of hydrochloric or similar nonoxidizing acids is not detrimental. Further, the presence of other chlorides, such as calcium, zinc, magnesium or ferric chloride, either individually or collectively, will not institute attack, as occurs in the cases of cast iron, steel and many ferrous alloys. Haveg fabricated into such articles as pumps, valves, pipes, fittings, storage tanks and dissolving tanks have given excellent service for years in such brine applications. Its use on a larger scale has been restricted primarily by economic considerations, but, where justified, has resulted in low amortization and maintenance costs.

Resistance to thermal shock, toughness and facility in making field alterations to existing equipment through the use of Haveg cements, which have resistance equal to the fabricated article, are but several of its merits.

DURIMET and CHLORIMET

WALTER A. LUCE
The Duriron Co., Inc.
Dayton, Ohio

EXPERIENCE has shown Durimet 20 to be a satisfactory material of construction for applications involving various sodium chloride solutions. As is the case with iron base alloys and especially the high chromium stainless steels which depend on an oxide film for their corrosion resistance, the Durimet alloy occasionally gives indications of the pitting type of corrosion.

Durimet 20 is an austenitic stainless alloy with a nominal chemical composition in the cast form as follows: 29 percent Ni, 20 Cr, 1.75 Mo min., 3.5 Cu min., 1.0 Si and 0.07 C max. A composition such as this produces an alloy that is much more resistant to pitting attack than the ordinary stainless steels with their lower alloy content. Durimet 20 will remain resistant to clean, aerated sea water but will pit when subjected to the varied oxygen concentration conditions initiated in dirty, unaerated sea water. For instance, the area beneath a barnacle or other adherent deposit is a typical concentration cell with pits forming due to insufficient oxygen replenishment in that area.

Similar reasoning may be applied to industrial sodium chloride solutions (brines). However, in these cases the oxygen supply is generally uniform throughout the system. Although this alloy was found to be susceptible to pitting attack under unaerated conditions, many industrial applications have been found in which it may be successfully applied. A few of these applications are as follows:

1. A production process in a soap plant involved recirculation and build up of sodium chloride at temperatures up to 180 deg. F. Durimet 20 gate valves are used extensively and they are giving very good service.

2. Durimet pumps are used in a chemical plant for circulating hot, dilute, caustic-neutralized organic solutions which contain appreciable amounts of sodium chloride. The pumps are giving excellent service in this type of solution.

3. In the production of commercial salt, Durimet equipment is showing excellent service for saturated salt brines at temperatures up to 280 deg. F.

The high-silicon irons are often preferred over Durimet because of the lower cost and better corrosion resistance. However, many applications require the use of machinable alloys, and it is generally for these conditions that Durimet 20 is used when applicable. Valves are often made with high-silicon iron plugs and Durimet bodies.

Durimet 20 is available in both the cast and wrought forms. Chemical equipment available in the cast alloy includes pumps, valves, fans, ejectors, jets, and mixing nozzles. Special cast-

Outstanding among its great variety of mineral resources readily available for chemical manufacturing is Oklahoma's tremendous reserve of high grade silica, in several forms:

Glass Sand. Equal in chemical quality to any in the United States and used by glass plants in Oklahoma and adjacent states since 1913.

Tripoli. This state has long been an important supplier of tripoli, in 1944 ranking third in national production.

Novaculite. Outcroppings of more than 100 square miles in southeastern Oklahoma are a continuation of the outcrops in southwestern Arkansas where novaculite has been produced for many years and where chemical analysis shows silica content to be 99% or more.

Vein Quartz. Very large deposits of milky variety are easily accessible.

Chat and Slimes. Millions of tons of highly silicious material are available as by-products of zinc mining in northeastern Oklahoma.

TYPICAL ANALYSIS OF SILICA GLASS SAND FROM ARBUCKLE MOUNTAINS

Average of Plant Run — 1947

SiO_2	99.829
Fe_2O_3	0.036
Al_2O_3	0.072
CaO	0.009
MgO	0.005
L. O. I.	0.072
Total	100.023

Detailed information on Oklahoma's mineral resources is available on request, based on data by the Oklahoma Geological Survey. Map showing location of mineral deposits is also available.

ings are available for manufacture of other special equipment. The Duriron Co. should be contacted for the available forms of wrought Durimet products.

Chlorimet 3 is a nickel base, high alloy material with a nominal chemical composition of 60 percent Ni, 18 Cr, 18 Mo, 2 Fe, and 0.07 C max. Laboratory tests indicate the complete resistance of this alloy to sodium chloride solutions at all concentrations and temperatures. Test results also indicate that Chlorimet 3 is resistant to sodium chloride solutions with contaminants present if the contaminants have no effect on this alloy by themselves. Chlorimet 3 is produced in the cast form only (pumps and valves at present) and it is machinable. Because of its inherent pitting resistance, Chlorimet 3 can be used for severe corrosion applications which require a machinable alloy.

Chlorimet 2 is also a nickel base, high alloy with a nominal chemical composition of 63 percent Ni, 32 Mo, 3 Fe max., and 0.15 C max. Severe laboratory tests were conducted on this alloy in various brine solutions in an attempt to induce concentration cell type attack, but Chlorimet 2 shows excellent resistance at all concentrations and temperatures tested. Contaminants of an oxidizing nature tend to attack this alloy because of its lack of chromium. Chlorimet 2 is produced in the cast form only and in the form of pumps and valves. It is also machinable and if desired, can be hardened to 475 Brinell by heat treatment.

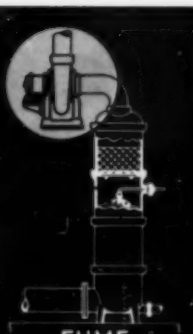
ALUMINUM

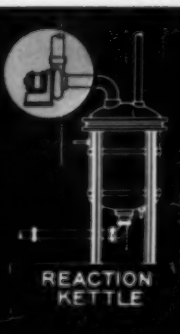
JOSEPH P. BALASH
Aluminum Co. of America
New Kensington, Pa.

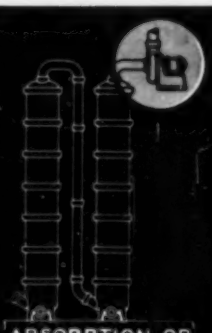
SODIUM CHLORIDE in both the solid form and as brines has been satisfactorily handled in aluminum equipment. Even in contaminated solutions the total amount of attack on aluminum is small. However, when certain contaminants are present, for example, compounds of heavy metals such as copper, nickel, and lead, the total amount of attack though small may be highly localized. If such dangerous contaminants are encountered, the corrosion hazard may be greatly minimized by the use of equipment fabricated from a duplex product known as "Alclad."

Because chloride solutions are especially effective in promoting galvanic corrosion of aluminum, equipment to handle sodium chloride solutions should be designed to avoid contact of dissimilar metals. For example, contact between aluminum and copper fixtures should be avoided. However,

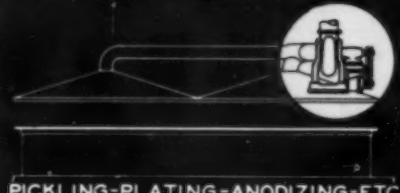
THESE FANS...

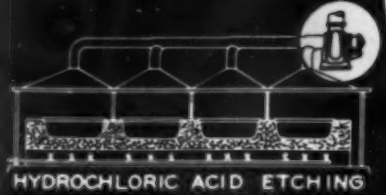


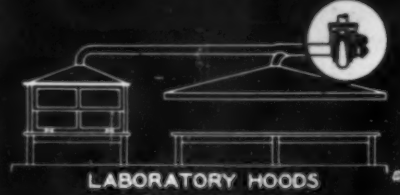




EVACUATE CORROSIVE FUMES *without* GETTING BURNED







Durco exhaust fans operate with a lasting efficiency that cannot be impaired by destructive fumes, vapors or gases.

Here's the reason: The vital parts of the fans—the parts in contact with the fumes—are made of Duriron, Durichlor or Durimet. These Durco alloys are uniformly *corrosion-resistant* throughout; require no coating or painting for protection.

DURIRON, of which standard Durco fans are made, is a high-silicon iron alloy containing approximately 14.5% silicon. It is highly resistant to the corrosive attack of all commonly used acids except hydrofluoric, sulfurous and oleum.

DURICHLOR is a high-silicon alloy, similar to Duriron, developed by Durco for resisting the corrosive action of hydrochloric acid below boiling point. It is similar to Duriron in resistance to other corrosives except that is superior for chloride solutions and chlorine gas.

DURIMET is a patented low carbon stainless steel containing nickel, chromium, molybdenum and copper. Durimet fans will safely handle the fumes of oleum, sulfurous acid, sulfur dioxide and hydrofluoric acid.

In addition to their extraordinary corrosion-resisting ability, Durco fans have many features of construction which permit:

- Easy access to all parts.
- Complete drainage of corrosive condensate.
- Removal of motor without disturbing fan connections.
- Rotation of volute to change direction of discharge.
- Minimum of maintenance. Most of the operation attention is confined to oiling the motor.

New Fan Bulletin No. 1102 gives complete information and engineering data. Write for your free copy.

DURCO Adv. 22-GM

DURCO
CORROSION RESISTING
ALLOYS & EQUIPMENT

THE DURIRON COMPANY, Inc.
DAYTON 1, OHIO
Branch Offices in Principal Cities

MEMO

TO: USERS OF HIGH PRESSURE COMPRESSORS

FROM: NORWALK COMPANY

A Compressor Must Breathe Fresh Air

Getting long life out of your high pressure compressor is mostly a matter of good common sense.

Take air, for instance. An important fact to remember is that air must not only be clean at its source, but at the point of delivery to the compressor. Intake suction lines can be and should be kept scrupulously clean for best results. Dust or grit entering the compressor plugs the valve parts, cuts the cylinders, and generally impairs efficiency.

The volume of air delivered by the compressor increases proportionately as the temperature of the intake air is lowered.

Make sure your compressor has a chance to breathe fresh, clean, cool air. You will find it pays.

Reprints of these messages available for your maintenance men

Norwalk Compressors are custom-built . . . of standard, interchangeable parts. This combines the best of craftsmanship and modern methods, to give you a sturdy, reliable compressor, individually assembled and tested for your specific requirements.

NORWALK COMPANY, INC.

10 NORTH WATER ST., SOUTH NORWALK, CONN.

Manufacturers of High Pressure Compressors for Air and Gases for more than 80 Years

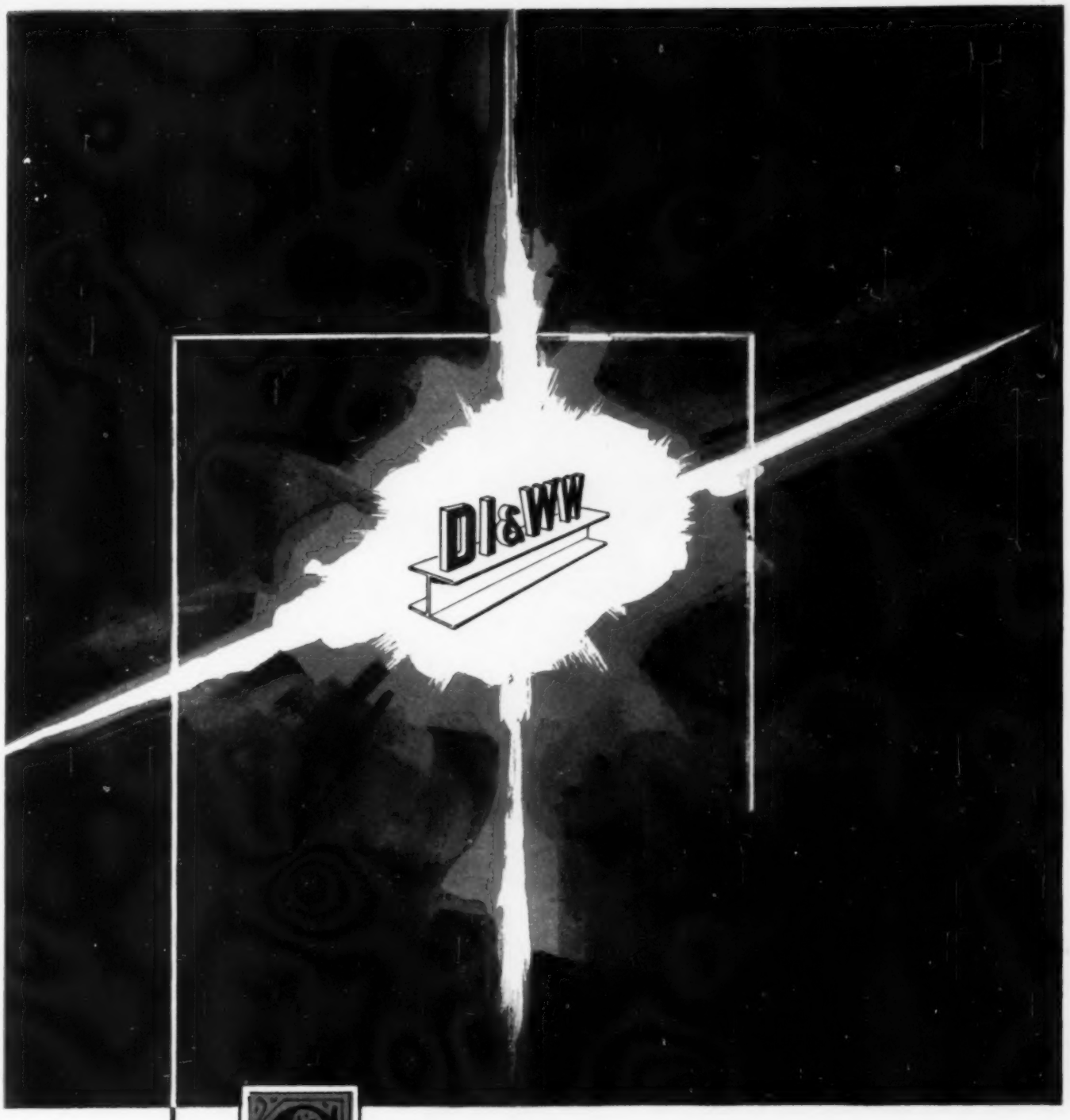
in many instances it is possible to cathodically protect aluminum in the presence of steel by the use of zinc or aluminum alloy attachments.

Marine Exposures. The high resistance of aluminum alloys to saline exposures has been demonstrated by the many applications in conditions where equipment has been subjected to sea water. Aluminum alloys such as 2S, 3S, 52S, and 63S are virtually unaffected by unpolluted sea water. Although very little difference exists in resistance to corrosion of these metals, 52S has been particularly outstanding in its resistance to marine conditions. If the water is polluted by industrial wastes, Alclad metals are recommended because they are especially resistant to localized failure. The service under corrosive saline conditions rendered by Alclad products is demonstrated by the widespread use of this material for flying boats, Alclad sheet being considered standard for marine aircraft.

Extensive service data from many aluminum products such as aluminum cable, cast aluminum spandrels, aluminum roofing sheet, aluminum alloy railing, aluminum alloy window frames, as well as exposure tests on practically every type of aluminum product, have demonstrated the excellent resistance of aluminum to weathering in marine atmospheres.

Brines. Brines, especially when inhibited, have been used successfully in refrigeration systems fabricated of aluminum alloys. Oil well brines are being handled in aluminum piping.

Condenser Tubes. Reference has been made above to the exceptional resistance to failure by localized corrosion of Alclad products. Alclad products are composed of a core alloy having the desired mechanical properties coated on one or both sides by another alloy having a potential sufficiently anodic to electrochemically protect the core when both are in contact with the electrolyte. Condenser tubes are available fabricated from Alclad 3S which consists of 3S core with the coating of the 72S aluminum alloy metallurgically bonded to the inner surface of the tubing. Hence such tubing is especially desirable for use in condensers in which the corrosive waters contact the inside of the tube. The 72S coating alloy was selected so that it would be anodic to the 3S core when exposed to natural waters or most substantially neutral solutions. Should a water be encountered which would normally cause localized pitting, the penetration of the full thickness of an alclad tube will be prevented for extended periods of time because of the protection rendered the core by the coating. The



CUSTOM STAINLESS STEEL FABRICATORS

In our years of custom metal fabrication for industry we have frequently discovered new techniques and improved methods that may be advantageously applied to your needs. ¶ Through our alertness to new developments, Dallas Iron & Wire maintains its ability to produce fabricated metals . . . faster and at reasonable cost. ¶ Send us your plans and specifications. . . . We will inform you promptly what we can do . . . and when.

DALLAS IRON & WIRE WORKS, INC.
6115 Denton Drive, Dallas 9, Texas

FILTER UNITS by MULTI-METAL

The illustrated filter cylinder, made of stainless steel wire cloth over carbon steel skeleton, is one example of Multi-Metal's "know-how" in the design and fabrication of filter cloth assemblies. The versatile ability to produce such intricate units is a natural result of 35 years of specialization in the wire and filter cloth field. That is why Multi-Metal fabricated filter units are so widely used in the processing industries to speed up production, increase equipment life, cut maintenance expense, and protect product purity.

Multi-Metal stocks a large variety of filter and wire cloth of all meshes, weaves and metals supplied by the yard, piece or roll. Send for wire cloth samples and catalog describing Multi-Metal's complete fabricating facilities. Include your prints and specifications for prompt quotations.

More than 35 *years of service to process industries*

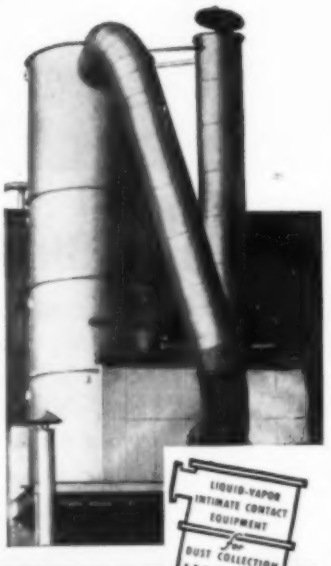
Multi-Metal
WIRE CLOTH COMPANY, INC.
1350 Garrison Ave., New York 59, N. Y.

BLOW-OUT
High Temperature Vapors with a SCHNEIBLE System

Just exhaust those high temperature vapors to a Schneible Multi-Wash Collector. A cool liquid (water or some chemically active solution) condenses your hot gases into finely divided mists or solid particles. These, with all other air contaminants, are impinged and completely removed as the sprays and curtains of falling liquid purge the rapidly rising air. The collected matter, as sludge, permits easy disposal, and the liquid is reclaimed for repeated use.

For every dust, fume and odor condition in your plant, Schneible has the final answer. Schneible Systems function for long periods with minimum care and maintenance. There are no parts in the collector to break, burn, clog or rapidly wear.

A Schneible System includes hoods, ductwork, collectors and dewatering equipment. Submit your air contamination problem or write for information.



CLAUDE B. SCHNEIBLE CO.
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SCHNEIBLE

Alclad 3S tubing can be formed, threaded, and expanded just as if it were ordinary 3S tubing. Hence from a purely technical, as well as economical standpoint, aluminum alloy tubing, especially Alclad 3S tubing, shows great promise for condenser tube use in salt water service.

Handling Salt. Since compounds of aluminum are usually colorless or white, traces of the harmless metal leave the color of the product or refined salt unaltered. Aluminum has been used for mining and drying machinery, structural materials in mines, and other miscellaneous equipment. The preliminary processing equipment such as hoppers, elevator buckets and shafts, as well as drying towers, are all composed of aluminum. Wooden shipping containers for salt are lined with aluminum sheet to prevent the egress of salt and ingress of moisture.

HASTELLOY

C. G. CHISHOLM
Haynes Stellite Co.
Kokomo, Ind.

EXPERIENCE with the corrosion resistance of Hastelloy alloys A, B, and C to sodium chloride has been limited, in general, to sea water applications. These alloys have been subjected to both spray and immersion tests.

Test samples of cast and of sheet alloy in all three grades were subjected to flowing sea water at a depth of 3 to 4 ft. in a channel which conducted sea water into a chemical plant on the Atlantic seacoast. Velocity of flow in the channel averaged 1 to 2 ft. per sec. Cast and sheet forms of Hastelloy alloys A and B showed generally uniform corrosion with some shallow pitting after 1,834 days. The depth of pit varied between 0.015 and 0.023 in. Of all alloys tested, alloy C was the most resistant. Cast, sheet, and welded sheet samples, as well as samples of cast pipe and welded tubing, all had an excellent to perfect appearance after 1,837 days of exposure, with no weight loss and no pitting.

Laboratory tests with alloy C in a 3 percent sodium chloride solution, held at a temperature of 158 deg. F. for 10 days, showed no weight loss and no pitting. Comparative tests were run upon equipment simulating condenser tube applications with alloy C and cupronickel alloy (70:30). Actual operating conditions were paralleled by exposing the test samples not only to high-velocity sea water, but also to air and violent agitation. Hastelloy alloy C showed a superiority 10 to 15 times greater than the cupronickel alloy. Alloy C was unaffected by standard-spray testing, even after 100 air runs.

Where economy of operation demands a material completely impervi-

8 Ways Reeves Speed Control Increases Production–Improves Quality

1. Widens the work range of machines to handle more shapes, sizes, materials.

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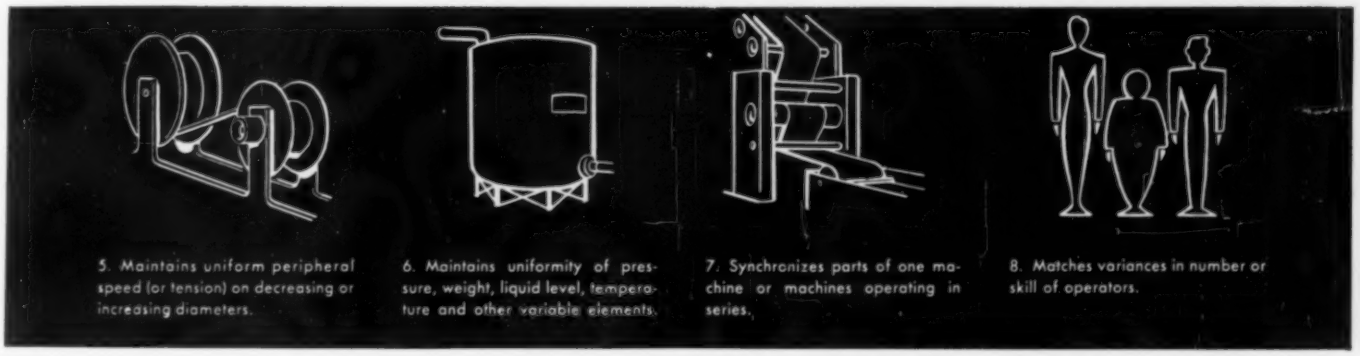

5. Maintains uniform peripheral speed (or tension) on decreasing or increasing diameters.

6. Maintains uniformity of pressure, weight, liquid level, temperature and other variable elements.

7. Synchronizes parts of one machine or machines operating in series.

8. Matches variances in number or skill of operators.

Here's the tested and proved way to get instant, stepless speed adjustability on your machines—assuring exactly the right speed for every job, under every changing condition.

REEVES Speed Control is standard equipment on more than 2,100 different makes of machines and is easily applied to your existing machines. Units are available in the widest variety of types, sizes, capacities and speed ratios with manual, push button or automatic control.

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Accurate Variable

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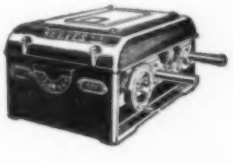
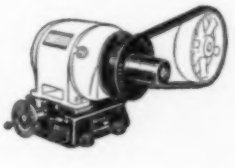
Gives the Right Speed for Every Job!

THE THREE BASIC REEVES SPEED CONTROL UNITS

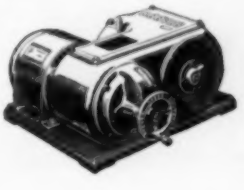
VARIABLE SPEED TRANSMISSION for providing infinite, accurate speed flexibility over a wide range—2:1 to 16:1. Sizes—fractional to 87 hp.



VARI-SPEED MOTOR PULLEY provides an instantly variable speed drive within 4:1 ratio for any constant speed motor. Sizes to 15 hp.



MOTODRIVE combines motor, speed varying mechanism and reduction gears in single compact unit. Speed variations 2:1 to 6:1 inclusive. Sizes to 15 hp.



● Where the cooling of liquids or gases is part of your process, the NIAGARA AERO HEAT EXCHANGER will save over 95% of the water you use for cooling.

An even greater advantage is the closer control of temperature which results in improved quality, reduced loss in rejections, and the speeding up of production performance.

Applications include cooling jacket water for process equipment or engines; cooling cutting oils, lubricants, hydraulic equipment; quenching baths of water, oils or solutions; electronic sets, transformers; controlled atmospheric processes, compressed air or gas cooling.

Write for the story of examples in your particular process. Ask for Bulletin 96-CM.

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ous to salt water attack, alloy C is recommended. An outstanding application of this alloy was in the 12-in. searchlight reflector developed for small naval vessels and landing craft. In addition to being impervious to salt water attack, the alloy selected had to be unbreakable; it also had to take a mirror finish with a high reflectivity that would remain constant indefinitely. Alloy C is likewise being tested for identification tags subjected to salt water corrosion.

An unusual application of alloy C involves its use in heat exchangers installed in a large chemical plant. The tubes carry aluminum chloride and hydrochloric acid. Salt water as a coolant is pumped into the jacket surrounding the tubes. Whereas the jacket would normally be fabricated of carbon steel for fresh water service, in this case alloy C was used to resist corrosion from the salt water.

Hastelloy alloy C, as well as alloys A and B, is available in the forms of castings, hot-rolled sheet and plate, hot-rolled bar stock, wire and welded tubing, and cast pipe and fittings.

STAINLESS STEEL

GRANT L. SNAIR, Jr.
Allegheny Ludlum Steel Corp.
Pittsburgh, Pa.

CHROMIUM-NICKEL types of stainless steel are resistant to sodium chloride solutions of practically all concentrations and temperatures, provided that a neutral or alkaline condition is maintained. Boiling solutions generally can be handled successfully unless the metal is in a stressed condition. The stainless steels usually are not satisfactory for prolonged contact with slurries or supersaturated solutions of sodium chloride. While freshly prepared sodium chloride solutions are neutral, hydrolysis during stagnation establishes an acid condition which will induce localized attack on stainless steel. Of all the stainless steel grades, Type 316 is most resistant to this kind of corrosion.

For most of the corrosion resisting services in industrial, food processing, and household applications where sodium chloride is encountered, stainless steel can be employed with highly satisfactory results. A wide variety of equipment ranges from small kitchen utensils and implements to the kettles, tables, and conveyors used in food processing plants. It includes vats and related apparatus for tanning, dyeing, and soap manufacturing and also circulating systems for controlled brines. Corrosion by marine atmospheres and sea water is resisted under most circumstances, and stainless steel is used

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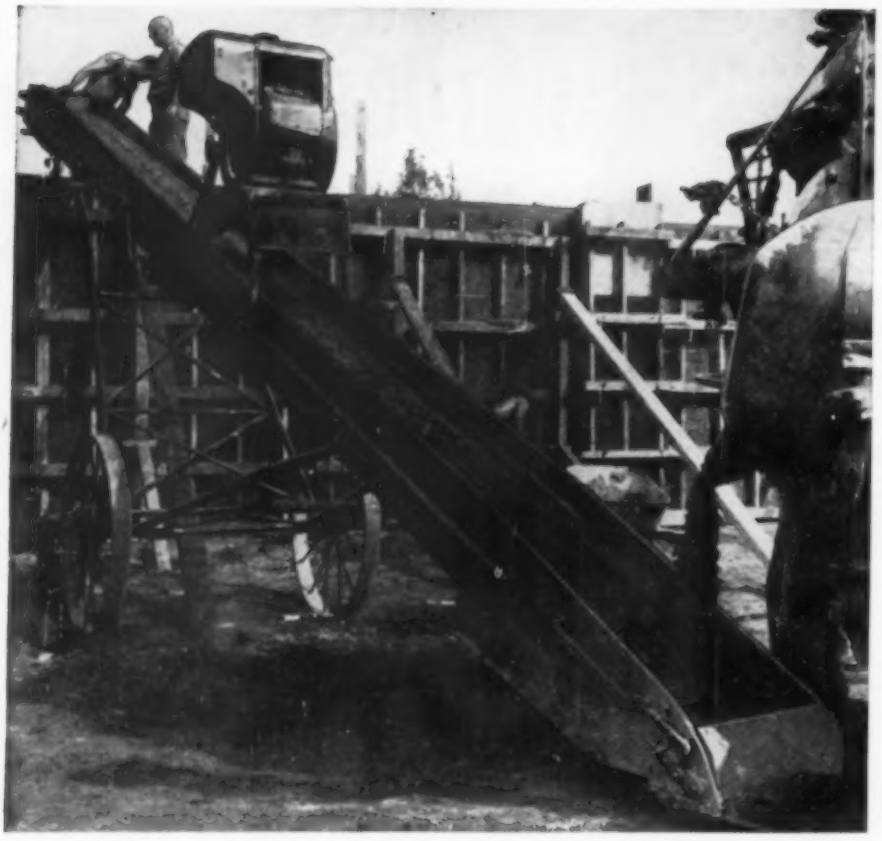

Farquhar Trough Conveyor

"PAYS FOR ITSELF"

handling wet concrete from mixer to forms

ON one job alone, handling wet concrete from mixer to forms, this Farquhar Trough Conveyor — Model 343 — more than *paid for itself* in time and labor saved. No hoist operator was needed; scaffolding was eliminated on this construction project . . . the Farquhar Conveyor fed concrete to the forms at the rate of one cubic yard a minute—faster than the contractor believed was possible.

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General-utility Farquhar Trough Conveyors handle sharp or abrasive materials, fine or powdery materials, small bags or bundles *faster, better, cheaper* than old-fashioned handling methods. Contractors, chemical plants, coal yards, warehouses—all industries turn to Farquhar for the right answers to specific handling problems. Farquhar offers a complete line of conveyors for portable, semi-permanent or permanent use, handling all kinds of loose or packaged materials. Tell us your problem—we have the know-how to help you. Write A. B. Farquhar Co., Conveyor Division, 219 Duke St., York Pa., or 616-A W. Elm St., Chicago 10, Ill.

MOVING DIRT *from basement excavation direct to dump truck with gas engine-driven Farquhar 334-T Conveyor saves time for contractor . . . hard, back-breaking work for men.*

Farquhar PORTABLE OR PERMANENT MATERIALS HANDLING CONVEYORS

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HYDRAULIC PRESSES
FARM EQUIPMENT
FOOD PROCESSING AND
SPECIAL MACHINERY

for small boats, fishing equipment, installations on seagoing vessels, and for decorative purposes on buildings along seashores.

Types 316 and 317, the modified stainless steel grades containing molybdenum, are more resistant than the other stainless steel grades to the attack by pitting which is characteristic of media containing sodium chloride. While Types 316 and 317 are subject to attack resulting from surface contamination, from prolonged contact with moist sodium chloride crystals or from slightly acid solutions of sodium chloride such as stagnant sea water, such hazardous conditions of exposure often can be eliminated by careful planning. Where the exposure conditions are severe, the service life of the metal can be extended by proper cleaning during and after use. In special cases where the exposure time is short or where the corrosive medium is very mild, the regular chromium-nickel grades may be suitable.

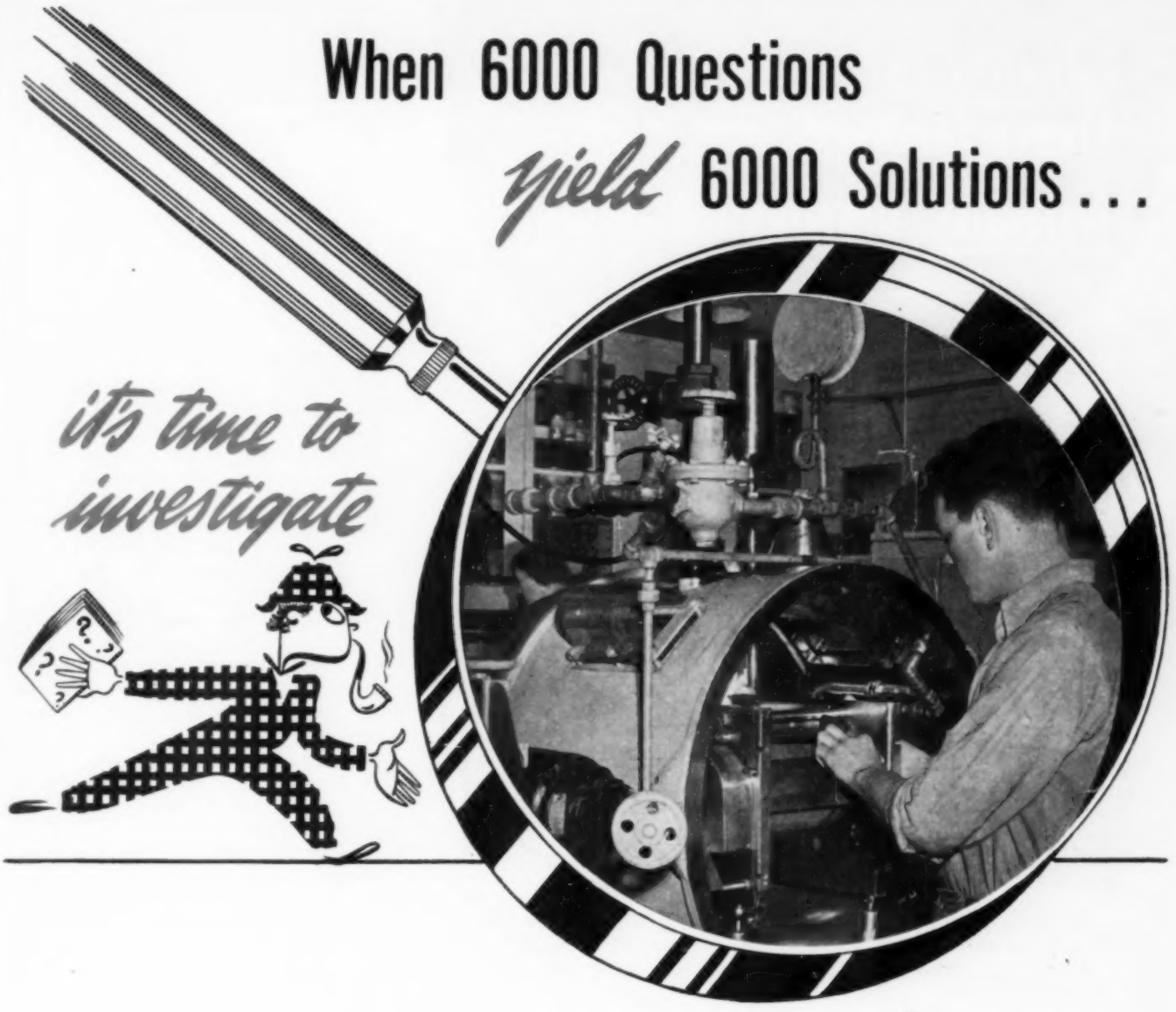
The corrosion resistance of stainless steel is highly desirable in the food processing and meat industries, where sodium chloride and various brines and sauces containing salt are used for processing, preserving, or flavoring. Kettles for mixing and cooking, tanks for blanching, troughs, molds, trays, tables, trucks, chutes, and conveyors are made of Type 304 or Type 316, depending upon the service condition. Slicers and packaging equipment for hams and bacon containing salt also are made of Type 316. Stainless steel thermometers are inserted in hams to observe temperatures during processing.

Type 316 resists the corrosive action of many, but not all, food flavoring sauces and brines for pickles. Most of the usual pickling solutions containing salt, vinegar, and sugar can be handled safely, and the equipment can be kept in good condition by flushing occasionally with water.

Type 304 pumps, piping and valves provide excellent service in refrigeration circulating systems for salt brines which are controlled to maintain constant alkalinity. Vats, rolls, and other apparatus used for tanning and dyeing withstand the action of alkaline solutions containing sodium chloride at boiling temperatures. In the production of soap, the "salting out" operation is carried out in stainless steel Type 316 vessels.

Tanks and vessels of stainless steel resist attack by some sodium chloride-acid solutions used for metal cleaning, food processing, and various other purposes. For example, certain solutions containing water, sodium chloride, sulphuric acid, and nitric acid are not harmful. The corrosive action of such

When 6000 Questions *yield* 6000 Solutions . . .



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At least 6,000 research processing problems have been submitted, studied and completed by BUFLOVAK Research Laboratories in the past 31 years. With this background of experience, BUFLOVAK'S highly specialized staff offer their mature counsel on processing problems, *without obligation.*

BUFLOVAK'S Research and Testing Laboratories are to assist customers in the solution of processing problems and to develop more efficient production methods and improved finished products. Modern, semi-plant units embodying the latest and most advanced design, are used . . . and practical research is employed in all problems involving drying, evaporation, extraction, impregnation, solvent recovery, crystallization and food processing.

These facilities can save you time and money, because they show *at the start* the commercial possibilities of your contemplated process, with production cost data and characteristics of the finished product.

Buflovak offers a complete line of Chemical Processing equipment, and the research and tests will show which equipment best fits your individual needs. You are cordially invited to submit your processing problems to us today.

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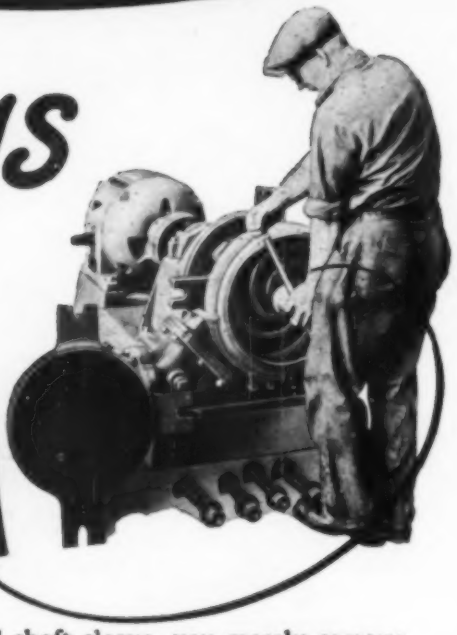
Impeller and renewable shaft sleeve removed...

WITHOUT DISTURBING PIPING!

MORRIS

TYPE "R"

SLURRY PUMP

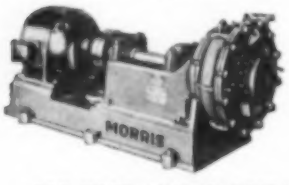


• Quick, easy access to impeller assures minimum lay-up time

To take out impeller and shaft sleeve, you merely remove four bolts and take off the end cover. No need to touch the suction and discharge piping. It's just as simple as a boy's mechanical set.

Stuffing Box maintenance at an all-time low

The Morris Type R differs radically from conventional end-suction type slurry pump. This newest Morris pump takes its suction from the driveside only. Hence, the packing is subjected to suction or positive head pressures only. The stuffing box is not nearly as vulnerable to entrance of solids. Not affected by fluctuating pressures in the sealing water main.



Easy Impeller Adjustment

Worn clearances on suction side of impeller can be very easily closed by four adjusting screws. This adjustment moves the entire rotating assembly as a unit, including impeller shaft, bearing and bearing housing.

FOR YOUR MINING OPERATIONS, use the Morris Type R Slurry Pump for mixtures containing ore concentrates . . . tailings, slag and residue from filters and classifiers . . . for handling all types of caustic or acid mixtures containing abrasives or solids.

Every Morris Pump is backed up by the engineering skill of 83 years' experience. It will meet your pumping requirements and do the job with *less maintenance . . . less trouble . . . less cost.*

MORRIS MACHINE WORKS, Baldwinsville, N. Y.
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MORRIS CENTRIFUGAL PUMPS

solutions of course varies with the concentrations of the ingredients as well as the solution temperature.

In the petroleum industry, Type 316 oil well tubing and housings for pumps are useful where brines are associated with the crude oil.

The performance of Types 302 and 304 used for decorative purposes on buildings and store fronts in marine atmospheres has been very satisfactory. Prompt drainage and occasional cleaning to remove salt deposits are advisable. Type 316 deck houses, railings, step treads, and window trim exposed for long periods of time aboard seagoing vessels have shown excellent resistance to ocean spray.

Corrosive effects resulting from the direct exposure of the stainless steels to sea water may depend upon additional factors. In all cases, Type 316 offers superior corrosion resistance. In actual service tests, Type 316 has remained unattacked during five years of immersion in fresh sea water. However, surface contamination over long time intervals by marine organisms, and the hydrolysis of the salt to create an acid condition in stagnant water can promote localized attack. Types 304 and 316 stainless steel equipment such as fishing lures, hooks, small boats, propellers, and linings in ship holds which can be rinsed occasionally to remove salt deposits or cleaned to dislodge organisms will provide satisfactory service. Storage tanks in which sea water is held stagnant are subject to attack if hydrolysis has occurred, but any of the chromium-nickel grades can be used if the water is maintained at pH 8 to 9 by the addition of sodium hydroxide.

Maximum corrosion resistance of stainless steel can be expected only when the metal is free of scale, inclusions, and flaws. In sodium chloride applications, crevices, loose joints, and depressed areas permitting stagnation should be avoided.

Sodium chloride is often used in solution or incorporated with other substances, and where corrosion is encountered, the attack is usually of a localized nature which cannot be evaluated by the ordinary calculated corrosion rates. For these reasons, specific data have not been included. When the use of stainless steel for sodium chloride applications is contemplated, complete details should be submitted for competent advice.

REPRINTS of the entire four-part symposium, "Sodium Chloride vs. Construction Materials," are available at 25c. from Corrosion Forum Dept., *Chemical Engineering*, 330 W. 42nd St., New York 18.

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Palladium has proven to be an unexcelled catalyst for liquid phase hydrogenation of terpenes, vitamins, alkaloids, and other organic compounds.

Our refinery is well equipped to insure complete recovery of the precious metals in exhausted catalyst material.

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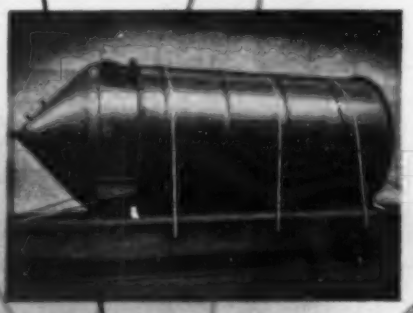
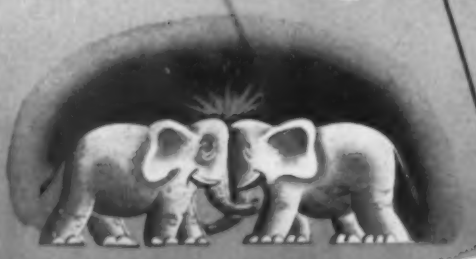


Tar Base Extraction Tank, fabricated of Monel Metal; 10'-0" diameter, 25'-7" high.



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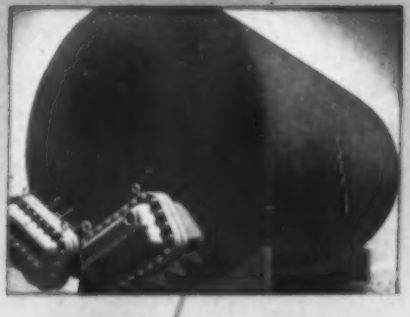
IN EVERY APPLICATION

Lead-Lined Jacketed Kettles with Lead Coils and Lead-Sheathed Agitators

Everdur Digester, pressure type, 10' dia., 25' lg. A.S.M.E. Construction, removable tube bundles.



Acme recognizes that the safe and efficient design of a vessel for high pressure or high vacuum service demands a complete consideration of all functional and mechanical requirements. For over a quarter of a century, Acme engineers and craftsmen have produced pressure vessels that have met successfully every requirement. Where necessary, Acme vessels are fabricated in accordance with A.S.M.E., A.S.M.E.-A.P.I. or T.E.M.A. Standards.

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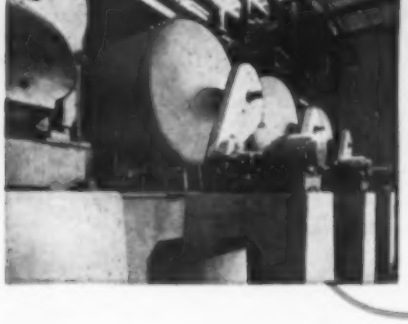

High-Pressure Grain Cookers.

ACME

Processing Equipment

ACME COPPERSMITHING & MACHINE CO., ORELAND, PA.

FROM THE LOG OF EXPERIENCE

Dan Gulleben, ENGINEER

POTASH was required by the Pittsburgh Plate Glass Co. Doc Joseph Kohn claimed to have discovered a process for its extraction out of beet molasses. This directed attention to beet culture and promised improved agricultural economy in the operation of the company's chickory farms above Owosso, Mich. Accordingly in 1903 the glass company commissioned Kilby Mfg. Co. of Cleveland to build a beet sugar works at Owosso. The chemical plant, which Joe subsequently built in Bay City for elaborating the molasses from the beet sugar factory, turned out to be a distillery, and under the skillful hands of himself and chemist Yasujuro Nikaido produced profit but no potash.

A grain distiller, competing for a large government order for alcohol, sought to prefer his product by the obsolete device of disparaging that of his competitor. He propounded to the purchasing officer that molasses alcohol was inferior. Uncle Sam must of course employ impartiality in his dealings with his nephews. The purchasing officer therefore gave Kohn an order for a carload and proved that alcohol was alcohol.

GEOFFREY FAIRRIE, managing director of the Liverpool refinery, possessed the inborn ability to count off seconds in competition with a stop watch. During his youthful exhibitions of humor he was want to exploit this gift for mystifying the gallery. He would wager a guinea that he could check off a minute within a tolerance of two seconds and, sure enough, when he called "stop," the stake holder's watch indicated exactly one minute. For the risk of another guinea he would accept the nervous strain of counting off a vulgar fraction, as for example 47 seconds. His "gift," as now revealed, was his poker face and the pulsing radial artery of his wrist. While he was nonchalantly folding his hands, his counting finger made contact with the artery.

DAVE JESSURUN, son of a Dutch father and Javanese mother, was discovered in a Dutch sugar house laboratory about 1890 by a planter from Cinclair, La. An agreement was set in writing under which Dave proceeded to Louisiana. The wide streets of New Orleans so impressed him that he determined that America was the place for him. Not even his fiancee could attract him back to Holland. Instead he sent for her and, since traveling as a maiden lady was beset with inconveniences, she took the marriage vow in her home while Dave's brother substituted for him at the altar.

Before leaving Holland, Dave had agreed for the generous monthly stipend of $50 to administer the laboratory at the Louisiana sugar house. As the sole occupant of the laboratory he developed versatility by covering the entire gamut of tasks from collecting samples to researching for improvements. He learned to his chagrin that the artisan on the pan floor was held in superior esteem to the extent that he received payment on the basis of 50¢ per ton of sugar produced. The planter refused to discuss the question on the ground that Dave's signature had settled it in Holland. However, by advice of the Dutch consul, Dave informed the planter that a written contract to import a laborer from a foreign land (and Dave's wage indicated that he was of this status) was illegal and subject to penalties. Thus Dave succeeded in substituting American abundance for European penuriousness.

CHEMICAL VERSATILITY is exhibited in Doc's solution of the little daily vexations. He had to reduce the width of the 12 in. space between the retorts and the wall in his experimental stillage recovery kiln to 4 in. The bricklayer's midriff would not admit him into this space and Doc didn't have the price of dismantling and rebuilding. So what? Doc loaned the bricklayer his laboratory roustabout "Skinny," who was lowered by means of a rope into the tar-and-soot-besmirched canyon about 8 ft. deep. The bricklayer handed him the bricks one by one ready buttered and directed placement from above. Skinny earned a little extra money but not enough to cover the cost of the soap necessary to remove the grime from his ears and hair and clothes. When his mother registered complaint, Doc magnanimously contributed a five spot.

FRED BATES, now emeritus physicist of the National Bureau of Standards, has changed horses. Custom and the rules of the Bureau leave no discretion or alternative when a certain date line is reached. Fortunately Fred has for years groomed a new activity that will continue to postpone atrophy. Whereas he has heretofore promoted "uniform methods" in the province of America, he will now devote himself to the more extensive organization bearing the style of "International Commission for Uniform Methods of Sugar Analysis." He was one of the principal instigators of this world wide activity and has been its front for many years. The 9th session was held in London in 1936. The 10th was set for Berlin in 1940 but Berlin did not receive visitors at that time and so the meeting was postponed. It is now scheduled to be held in Prague next August. Fred, as president, will be on hand to direct and coordinate the work of the largest assemblage of sugar scientists that has ever collected at one time and place.

AT THE BEGINNING of Fred's work at the Bureau in the early 1900's he found it advantageous to improve his tools of research. Accordingly he evolved the Bates polariscope and thereby created one of the great Before-and-Afters in the industry. Before:—a beet farmer for the St. Louis Park factory above Minnehaha Falls in 1899, advised his fellows that the only thing that he feared was "that drugstore where a man looks through a spy glass and then tells you to take your beets home and feed them to the cattle." After:—Ten years later, the fear having been dispelled by Fred's polariscope, an ad appeared in a Louisiana sugar journal calling for a man to clerk in the store and read the polariscope.

FRED'S BUREAU is one of the divisions that spalled from "Pure Food" Wiley's department. In the 80's, search was instituted for a source of domestic sugar to provide some meas-

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ure of agricultural economy and to restrain the cane sugar octopus. The big problem was solved with the establishment of the beet sugar industry. The industry grew and then it doubtless seemed desirable to promote some competition! Fortuitously the corn farmers produced a great surplus and besought Uncle for relief. Fred was right in the middle of this problem. Happily he selected a wizard from the beet sugar industry and, with the facilities of his Bureau, the solution was evolved in a process for the production of hard anhydrous corn sugar. The farmers and the corn processors (and possibly the corn pit) extracted great advantage. After this, Fred directed his efforts towards the production of levulose from Jerusalem artichokes. When this is achieved, the new sugar, having nearly twice the sweetening effect of cane sugar, will be king for awhile. However, there is in the offing another sugar of still greater potency that is prophesied by the Einsteins of the industry. With Fred, if it isn't one sugar it's another. The old industry gets a kick in the pants and a new one is born. Such is progress.

BATTLESHIPS anchored off New Orleans in the good old days of 1900. This gave opportunity to arrange athletic contests with the boys of Louisiana University. The matches were unequal as the seasoned marines excelled in age and experience and they could play a superior game of poker. However, around 1909 the University possessed a post graduate student in the person of Ernst Kopke, whom they were willing to match with any web-footed gob or leatherneck on the ship. The ship's money was boldly posted and the college boys matched it albeit with the generous assistance from local sources. When news came to the ears of President Boyd, the match was declared off. The President knew that no man or fish could prevail against Kopke. Moreover he considered it unseemly that his boys should engage in a game of chance with the dice loaded. What would have happened to the ship's money became clear when for exhibition purposes, Ernst suffered his ankles to be lashed and his wrists to be shackled behind his back. In this condition he was cast into Old Man River off Cat Island and thus swam seven miles to Biloxi.

Incidentally Ernst continues in his perennial globe-trotting practice. He is the sugar technologist on the staff of Smith Hinchman & Grylls of New York and may without notice be off for China, the Philippines, or any tropical land where sugar might grow.

When the once-familiar cry of "Any ice today?" heralded the ice wagon's arrival, some 50 years ago... studies and experiments in the development of light fraction petroleum refining were already begun at Standard Oil.

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CATALYTIC PROCESSES	Its tremendous surface area, absorptiveness, light weight, etc., make Dicalite an efficient carrier for catalysts.
CLEANSERS & POLISHES	The diatom structure of Dicalite enhances scouring action, and its high bulking effect adds considerable volume at low cost.
EXPLOSIVES	Efficient absorbent and anti-caking agent for nitro-glycerin and other explosive ingredients, and for pyrotechnic compositions.
FERTILIZERS	Anti-caking properties are of high value in ammonium nitrate and other fertilizers.
INSECTICIDES	Great surface area, high absorption and light weight of Dicalite improve dusting and spraying qualities and insure maximum coverage when used as a carrier or diluent.
PAPER	Dicalite is used in paper and paperboard products to improve sheet formation, speed up drying, increase production; also for pitch and asphalt control.
PAINT, VARNISH, ETC.	Inert flatting agent and extender for all types of paints and paint products. Flats most effectively, improves brushing and leveling, increases durability.

These are typical of many industrial uses. Full information on how Dicalite may be able to improve production and reduce costs in your plant will be sent on request to our nearest office.

DICALITE Mineral Fillers are produced from diatomaceous silica, a material deposited several million years ago on the bottoms of oceans and lakes. They are composed of the siliceous remains or "skeletons" of minute aquatic plants called diatoms.

Chemically, the finished materials are practically pure silica (SiO_2) and inert. They are amorphous in character (not crystalline), comparatively soft and friable, and free from gritty matter. Following data give the range of properties of the many grades of Dicalite available for filler use.

Colors .....gray white, buff, white
Particle Size.....from all through 150 to trace on 325 mesh screen
Weight (loose).....8 to 13 lbs. cu. ft.
Surface Area..20,000 to 100,000 sq. ft. per lb.
Porosity .....approximately 90%
Melting Point .....approximately 2900° Fahr.

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DICALITE MINERAL FILLERS

NAMES IN THE NEWS

Man of the Month

C. W. Balke

On January 9 the nineteenth Perkin Medal was awarded to Dr. Clarence W. Balke, Midwest scientist whose pioneer work in the rare metals resulted in major contributions to American industry and medicine.

Dr. Balke received the 1948 award for research which led to development of processes for production and utilization of tantalum and columbium as well as for extensive investigations in the field of ferrous powder metallurgy.

Dr. Balke was born at Auburn, Ohio, March 29, 1880, graduated from Oberlin College in 1902 and received his Ph.D. from the University of Pennsylvania in 1905. After teaching at Kenyon College and the U. of P. he joined the Fansteel Corp. in 1916 to organize a research laboratory. In 1921 he produced the first ductile commercial rolled sheet of tantalum; in 1927 developed a commercial process for columbium production; and during the war he assisted in the atomic bomb project, working closely with the staff of the University of Chicago and supervising Fansteel production of special materials.

Joseph A. O'Connor, who joined the staff of *Chemical Engineering* as an editorial assistant in August, has been made assistant editor. Mr. O'Connor is a graduate of Seton Hall College and later took work in chemical engineering at Pennsylvania State College. After four years in the Chemical Corps he was employed as production supervisor in the synthetic resin plant at Newark, N. J., of U. S. Industrial Chemicals, Inc.

Walter J. Murphy, American Chemical Society editor, has been awarded the honorary degree of Doctor of Science by Centre College.

Thomas R. Thompson of the Ansco division of the General Aniline and Film Corp., Binghamton, N. Y., has been elected chairman of the Binghamton Section of the American Chemical Society. He succeeds **Benjamin R. Harriman,** also of General Aniline.

Walter Wade Robinson and **Robert N. Roberts** have joined the staff of Southern Research Institute to work on problems in physical chemistry.

Irving H. Taylor, president of Merchants Chemical Co., has been named a director of the McGraw-Hill Publishing Co. and its subsidiary, the McGraw-Hill Book Co.

Phyfe

I. H. Taylor

M. T. Bogert

Marston Taylor Bogert, emeritus professor of chemistry at Columbia University has been appointed senior scientific advisor of Evans Research and Development Corp. Col. Bogert is an authority on synthetic organic chemistry.

Roger C. Sonnemann has been appointed industrial relations director for the Monsanto Chemical Co. plant at Everett, Mass. He was previously superintendent of the sulphuric acid department.

Games Slayter, vice president in charge of research development of Owens-Corning Fiberglas Corp., has been chosen to receive the 1948 Industrial Research Institute medal presented for outstanding contribution to the field of industrial research. The medal will be presented February 5 during the winter meeting of the Institute at Rye, N. Y.

M. S. Carr

R. A. Kaberg

Marvin S. Carr and **Russell A. Kaberg** have recently been added to the staff of the development department of Wyandotte Chemicals Corp. Dr. Carr will serve as assistant to the director of development and Mr. Kaberg will be a field representative in connection with the various organic chemicals that are being developed by Wyandotte.

Frank J. Soday has been appointed director of research of Lion Oil Co. In that capacity Dr. Soday will conduct an expanded and intensified research program in all departments of the petrochemical field.

W. L. Ducker has been named professor of petroleum engineering at Texas Technological College and will serve as head of the department for the remainder of the 1947-48 year.

H. Bloemgarten, vice president of exploration and production of Shell Oil Co. has been appointed managing director in charge of the technical operations of the Royal Dutch Shell Cos. His headquarters will be at the Hague.

Arthur C. Dreshfield and **Cleveland B. Hollabaugh** have formed a partnership known as Hollabaugh and Dreshfield with offices at St. Albans, N. Y., and LaGrange, Ill. They will specialize in the fields of stock preparation, sizing, coating, saturating and laminating, and the chemical and engineering

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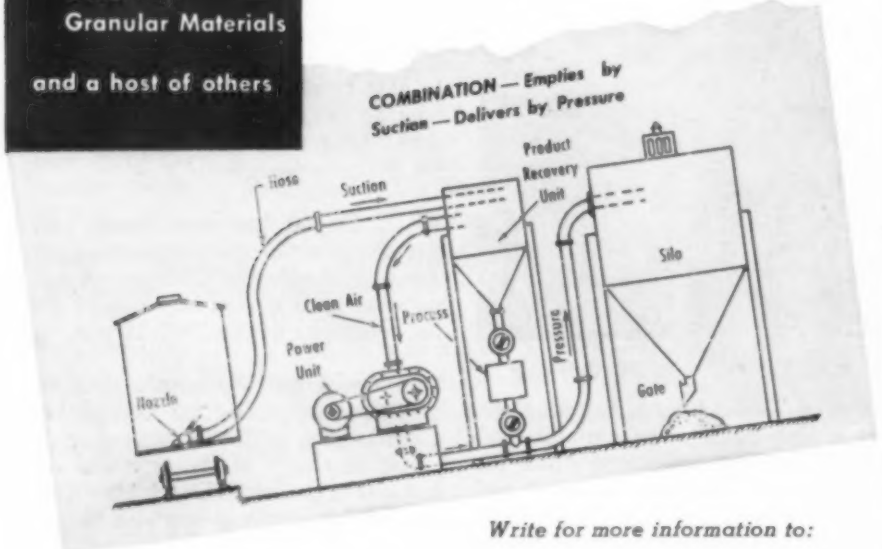

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processes of those operations and their patent aspects.

Sidney A. Savitt, former instructor in chemical engineering at Polytechnic Institute of Brooklyn has jointed the technical data department of the W. L. Kellogg Co. in New York.

Arthur B. Hersberger has been named manager of the recently organized chemical products division of the Atlantic Refining Co. This division will have the responsibility of coordinating company activity in the fields of chemical research, chemical manufacturing and chemical sales.

A. B. Hersberger

T. H. Manninen

T. H. Manninen has been appointed manager of development of U. S. Industrial Chemicals, Inc., and in this capacity will have general supervision of all pilot plant and engineering development activities. Dr. Manninen has been associated with USI since 1937.

Wallace Reed Brode, internationally known chemist, has been appointed associate director of the National Bureau of Standards. He succeeds **Hugh L. Dryden,** who was recently appointed director of aeronautical research of the National Advisory Committee for Aeronautics.

W. R. Brode

F. M. Hildebrandt

F. M. Hildebrandt has been appointed director of laboratories of U. S. Industrial Chemicals, Inc., and in this capacity will have general supervision of all research activities of the company in the Baltimore area.

John H. Lux has been appointed director of research on asphaltic specialties at the Chicago Research Laboratory of Witco Chemical Co. Dr. Lux was formerly assistant director of re-

Jacketed Drier Rolls Paid for Themselves in 268 Days!

THIS IS HOW IT WAS FIGURED

$$\frac{\text{Tons produced by machine per day}}{\text{Total number of drum driers}} \times 15\%^{*} = \text{Additional tons per Lukenweld Drier per day}$$

$$\frac{\text{Cost per Drier}}{\text{Additional tons} \times (\text{Operating Cost} + \text{Operating Profit})} = \text{Number of days for LW Rolls to pay for themselves}$$

*15% is the increased production per Lukenweld Drier and with all rolls (cast and Lukenweld) operating at only 50 psi.

A company which installed Lukenweld Jacketed Drier Rolls to replace several cast-iron rolls in a drying machine showed that the Lukenweld Rolls paid for themselves in 268 days. This was the result of the 15% additional output per Lukenweld Roll. From then on the increased production was clear profit.

In its estimates the company used these costs:

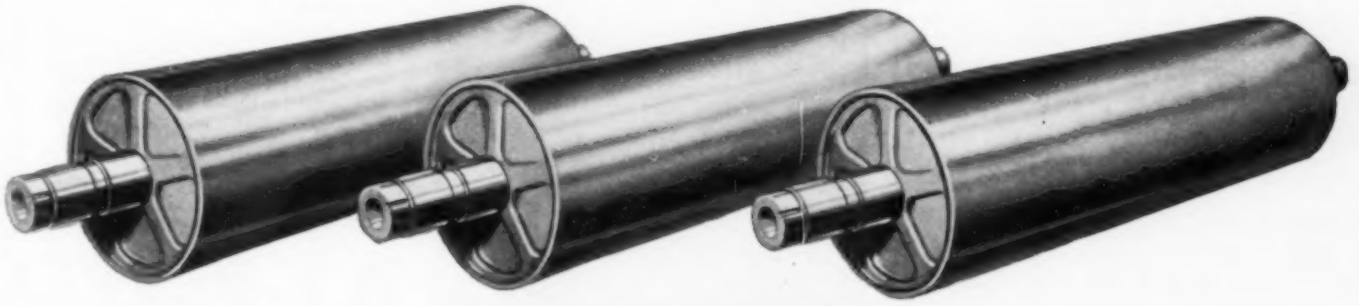
$40.00 = Raw Material Cost
+ $25.00 = Operating Cost
$65.00 = Cost per Ton of Product

Based on a selling price of $85.00 per ton, there was an operating profit of $20.00.

Using the above formula based on all rolls operating at 50 psi steam pressure, the user showed that the Lukenweld Rolls paid for themselves in 268 days.

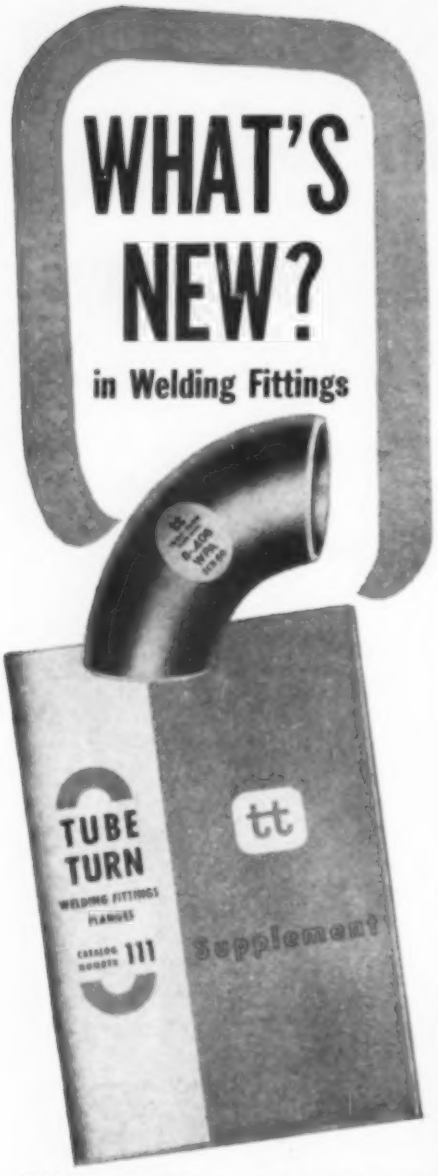
This company, however, is running its Lukenweld Rolls at 150 psi. Had the estimate been based on this higher pressure, with the resultant 48% additional output per Lukenweld Roll, it would have shown that the rolls had paid for themselves in 85 days.

For additional details, write to Lukenweld, Division of Lukens Steel Company, 400 Lukens Building, Coatesville, Pa.



LUKENS
LUKENWELD DIVISION

LUKENWELD
DRIER ROLLS AND DRYING MACHINERY



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J. A. Patterson W. W. Waterman

L. A. Wasselle W. L. Bass

search of the Neville Co., Pittsburgh, and research engineer at Carbide and Carbon Chemical Corp., South Charleston, W. Va.

John A. Patterson, formerly chief project engineer of Publicker Industries has joined the Rust Engineering Co., Pittsburgh. With **W. W. Waterman**, **L. A. Wasselle** and **W. L. Bass**, chemical engineers also formerly with Publicker, Dr. Patterson will assist Rust in forming a new chemical process design division.

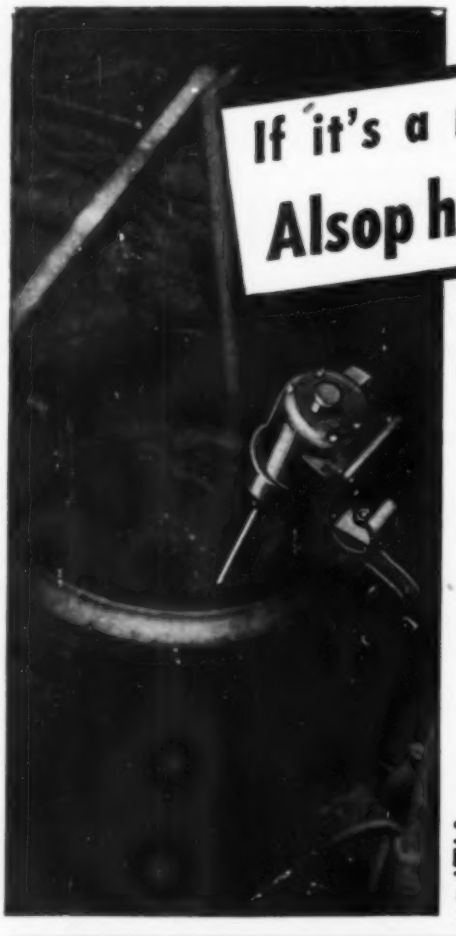
Joseph F. Battley has been elected president of the National Paint, Varnish and Lacquer Association, Inc. He succeeds **Ernest T. Trigg** who retired after 14 years as president of the association to become its chairman.

Weston G. Frome, general manager of the Atlas Powder Co.'s explosives department and a member of the board of directors, has been elected a vice president of the company. He will continue as head of the explosives department.

J. W. McCoy has retired as a vice president and member of the executive committee of E. I. du Pont de Nemours & Co. **William H. Ward**, general manager of the company's explosives department, has been elected a director, vice president and member of the executive committee.

Nathaniel Hill has joined the instrumentation department of H. K. Ferguson Co. in Cleveland.

Donald L. Fuller, Carl Barnes and **Fritz Max** have been promoted to the office of associate directors of the research laboratory of General Aniline & Film Corp. at Easton, Pa. W. W.



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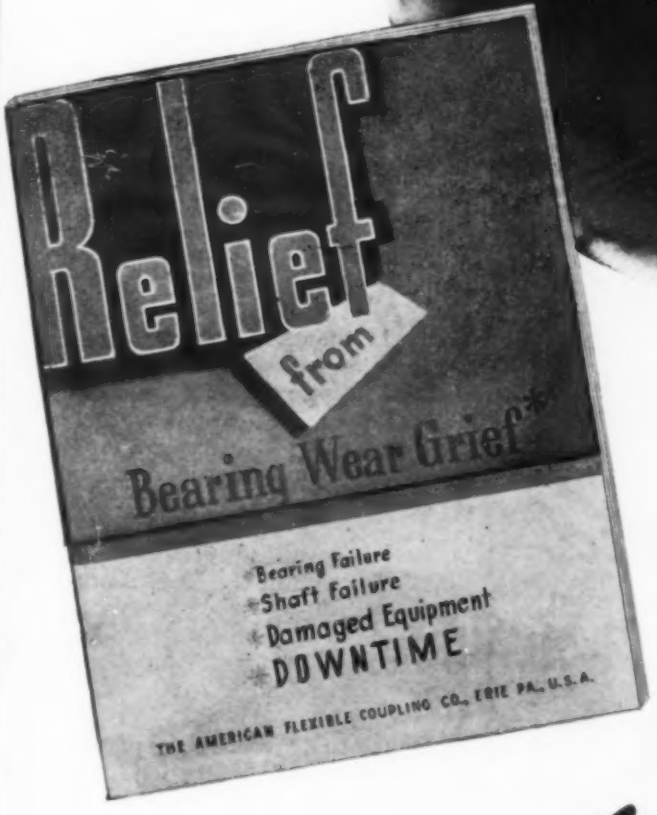
The American Flexible Coupling relieves Bearing Wear Grief because it is [illegible] around a Non-[illegible] Floating Center [illegible] which provides [illegible] and compensates [illegible] alignment without [illegible] damaging reaction-[illegible] stresses.



This booklet reveals how abnormal bearing wear, creating Bearing Wear Grief, eventually and inevitably results in damaged equipment and downtime. It presents practical help for the relief of Bearing Wear Grief. We believe design engineers will achieve a greater insight into the true functions of flexible couplings. Plant engineers, master mechanics, and maintenance men will definitely benefit, because herein are answers to many questions—what causes Bearing Wear Grief—bearing failure, shaft failure, damaged equipment, DOWNTIME. Write for your copy on business letterhead.

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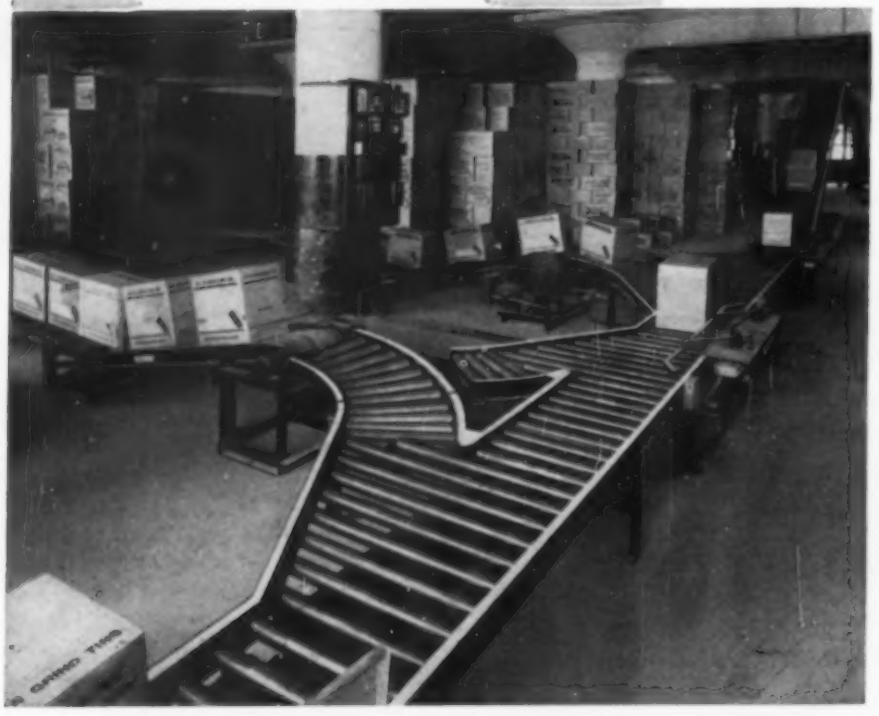

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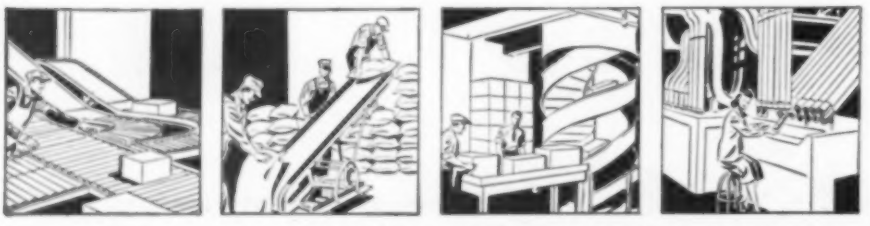

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Williams has been transferred from the Rensselaer dyestuff plant to the central research laboratory as the azo dye section leader. **John Copenhaver** and **Clyde McKinley** have been promoted to section leaders in the new products department of the laboratory.

William C. Dearing has been appointed director of research of Plaskon division, Libbey-Owens-Ford Glass Co., Toledo.

M. W. Brubaker has been promoted to director of research for the laboratories of Du Pont Co. chemical department and director of services for the company's experimental station. **P. L. Salzberg** succeeds Dr. Brubaker as laboratory director at the experimental station. The promotions took effect last month following the retirement of **Arthur P. Tanberg** as administrative director of the department.

John W. Boyer and **R. L. Sebastian** have formed the consulting partnership of Boyer & Sebastian in Washington, D. C.

Harold W. Johnson has joined Walter Kidde Constructors, Inc., of New York as chemical engineer in connection with the design and construction of chemical plants.

Halwyn R. Smith has joined General Electric Co. at Richland, Wash.

Max Gelfand, formerly chief chemist with Dallas Power & Light Co., has opened an office in Dallas as an industrial consultant and chemist.

J. Elston Ahlberg has joined the research staff of the Davison Chemical Corp., Baltimore.

Lester L. Stout, former member of the technical laboratory of the organic chemicals department, E. I. du Pont de Nemours & Co., Boston, has been appointed assistant to the director of the Ohio State University Research Foundation.

C. Paul Hegarty has been appointed director of antibiotic research and **L. D. Wright** is director of nutritional research at Sharp & Dohme, Philadelphia. The antibiotic department is newly created.

Seymour Calvert, chemical engineer, has joined the staff of Battelle Institute, Columbus, Ohio, where he will be engaged in organic research.

Robert L. Smith has been appointed to supervision of the project evaluation division in the research and de-

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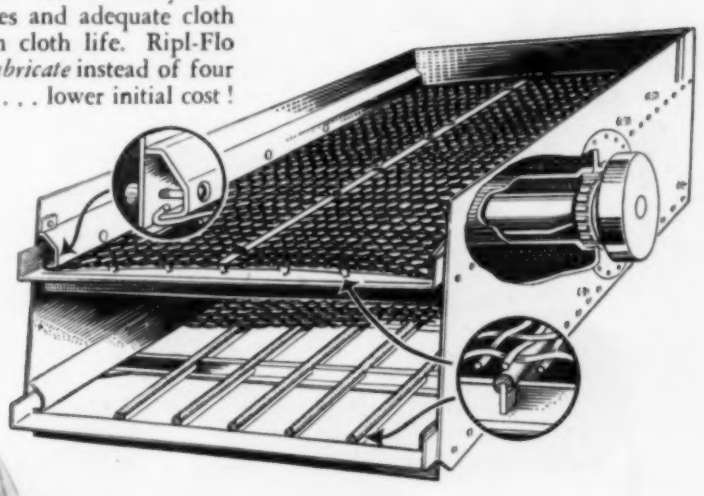
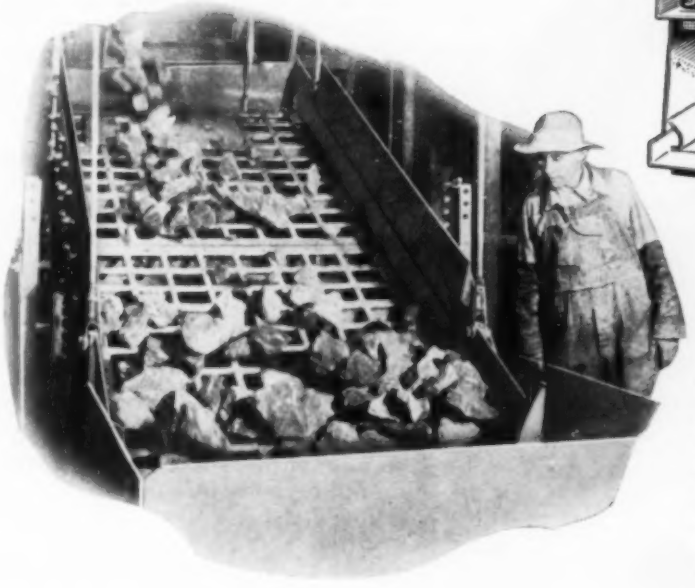
1. HOW IT'S BUILT: Take a close look at Ripl-Flo screen if you want to see long-life construction! Made of high strength alloy steel with all welded parts "stress-relieved" for durability. Accurately crowned support frames and adequate cloth supports greatly increase screen cloth life. Ripl-Flo screen has only *two bearings to lubricate* instead of four — less weight and maintenance . . . lower initial cost!





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• Ripl-Flo vibrating screens are built by Allis-Chalmers in 15 sizes from 3 x 6 to 6 x 16 ft, with one, two or three decks. Their use has resulted in *more profitable operations* in screening a wide range of materials. Send for Ripl-Flo Bulletin 07B6151B. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

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A FLARE FOR PROTECTION . . . Side wings on this metal-edged, easy-to-wear Protecto-Shield* give extra protection . . . deflects splashing liquids from face, head and eyes.

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FOR SPLASH-PROOF EYES . . . Rolled, resilient edges of this Over-All* rubber mask goggle hug facial contours to keep out chemical splash and metal spatter. Tops in comfort and protection.

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DOUBLE BARRELED PROTECTION . . . Two replaceable chemical cartridge filters highly effective against low concentrations of vapors; provide low breathing resistance.

*Reg. U. S. Pat. Off.

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velopment department of Sinclair Refining Co. at East Chicago. The assignment was made in conjunction with the scheduled expansion of research activities to be carried out at the new laboratories in Harvey, Ill.

John M. Campbell has recently been appointed to the Gulf Oil Corp. Fellowship which was established in the School of Chemical Engineering at the University of Oklahoma in July 1947. He is now an instructor in the school.

J. M. Campbell

V. B. Shelburne, Jr.

Victor B. Shelburne, Jr., has joined the staff of the Institute of Textile Technology where he will work in the division of chemical engineering. Just prior to coming to the institute Mr. Shelburne was with Spencer Kellogg & Son as supervisor-chemist of their Buffalo refinery.

S. E. Tray, who in February 1946 was named assistant manager of the Allis-Chalmers basic industries department in charge of the chemical processing section, has now had his title changed to manager of the chemical processing machinery section of the same department.

OBITUARIES

Christopher G. Atwater, 77, retired member of the staff of the Barrett Co., died at his home at Tarrytown, N. Y., during October.

Robert C. Wickersham, 52, Koppers executive, died in Pittsburgh November 28.

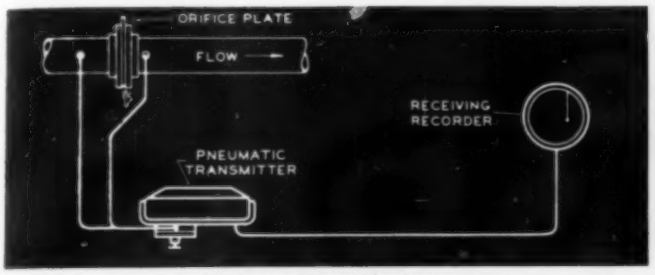
Richard Franchot, 72, chemist and inventor, died in Washington November 28.

Wesley G. France, 55, professor in the department of chemistry at Ohio State University, died at his home in Cleveland December 4.

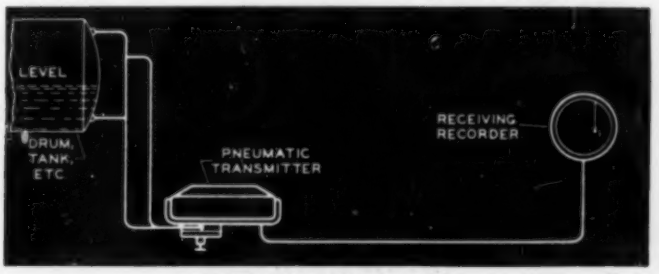
Edwin C. Wise, 45, head of the Upjohn Co. nutrition department, died on Dec. 7 in Ann Arbor.

Alfred L. Fenton, 64, director of the agricultural department of Texas Gulf Sulphur Co. died suddenly in Houston, Tex., December 8.

For The Measurement Of CORROSIVE FLUIDS



FLOW TRANSMISSION



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Without Mercury Seal Pots Purge

Republic pneumatic transmitters, of the force-balance type, for the measurement of flow and liquid level are now available with "Teflon" measuring diaphragms. All metal parts in contact with the measured fluid can be 316 stainless steel, Monel or bronze as specified.

Republic transmitters operate on the pneumatic force-balance principle, in which the force developed across a diaphragm by differential pressure is balanced by the force developed under an external diaphragm by pneumatic pressure.

Mercury is not used, and the development of corrosion resisting materials permits the introduction of many highly corrosive fluids, such as concentrated sulphuric acid and acetic acid, directly into the measuring chambers without the use of seal pots, separating liquids or purges.

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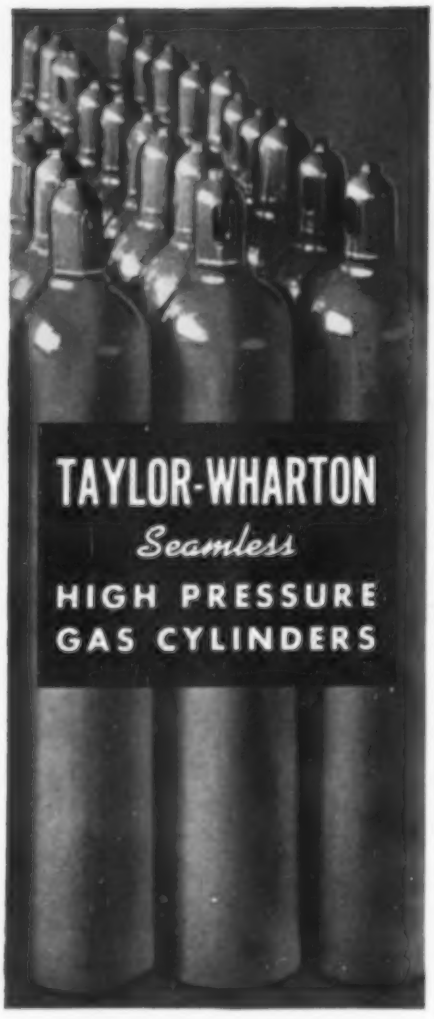

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INDUSTRIAL NOTES

Hewitt-Robins Inc., Buffalo, N. Y., has appointed Industrial Equipment Co., Louisville, Ky., as distributor of the entire Hewitt Rubber Division's line of hose, belting and packing.

Armstrong Cork Co., Lancaster, Pa., has elected Frederick C. Crawford to the board of directors.

Sharp & Dohme, Inc., Philadelphia, has moved the Detroit district sales office to the new Columbus headquarters at 226 East Sycamore St.

Tube Turns, Inc., Louisville, has placed Norton P. Bosemer in charge of the Los Angeles office and Robert S. Tyler, Jr., in the new mid-continent district with headquarters at 311 Tuloma Bldg., Tulsa, Oklahoma.

Delaware Chemicals, Inc., Wilmington, is a new company producing pentaerythritol and related chemicals. Exclusive sales agent is R. W. Greeff & Co., Inc., 10 Rockefeller Plaza, New York.

General Aniline & Film Corp., New York, has enlarged its special products division, now known as Antara Products, with offices at 444 Madison Ave., New York, to handle sales and distribution of the household products and certain chemicals for industrial markets.

General Aniline and Film Corp., New York, has appointed Arthur L. Van Der Kar district manager of the Binghamton district.

Dixie Machinery Mfg. Co., St. Louis, has elected Elmer W. Noxon president. H. H. Storck was reelected secretary and J. L. Leykam treasurer.

B. F. Goodrich Co., Akron, has named William W. Scull general manager of manufacturing services.

Stanolind Oil and Gas Co., Tulsa, Okla., has announced its intention of building a natural gasoline plant in the Levelland Field, Hockley County, Tex.

Pittsburgh Plate Glass Co., Pittsburgh, has appointed Charles E. Weeks assistant to the operating vice president of Southern Alkali Corp.

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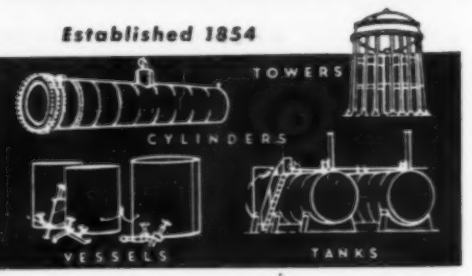

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Chase has had more than 100 years of *experience* in manufacturing bags of all types. Our engineers will be glad to consult with you on your own specific or unique requirements. Your nearby Chase Salesman will be glad to provide full information.

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PASTED SEAMS!

Chase crinkled and pleated liners stretch in ALL directions. NEW pasted seams assure added protection, prevent contents from sifting. Available in all sizes, Chase Liners for bags, boxes, and barrels keep contents dry and free from outside contamination.

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You cannot use wet tables or use flotation reagents on half-inch particles . . .

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S&S
THE PROCESS FOR BETTER PRODUCTS-FASTER

His headquarters will be at the Corpus Christi plant.

American Cyanamid Co., Bound Brook, N. J., has completed the first production unit of the Willow Island, W. Va., plant of the Calco Chemical division. D. H. W. Felch is plant manager, J. W. Dykes is production manager and R. C. Lantz, personnel manager.

Publicker Alcohol and Chemical Sales Corp., Philadelphia, has appointed Commerce Petroleum Co., 2923 Lock St., Chicago, as a distributor.

Allis-Chalmers Co., Milwaukee, has organized a fifth region for the field organization of the general machinery division under Arch J. Cooper. Territory covered includes New York, Buffalo, Rochester, Syracuse and Newark. William J. Devers is the Newark manager; Ned W. Landis, Syracuse; H. E. Weiss, Buffalo; and R. G. Burns special representative of the Rochester office.

U. S. Industrial Chemicals, Inc., New York, has announced that the insecticide division of its subsidiary, Dodge & Olcott, Inc., will be transferred to U.S.I. and operated as a part of the parent company. R. B. Stoddard will be director, J. A. Rodda will be in charge of sales, research and development will be under direction of Dr. W. E. Dove.

Laclede-Christy Clay Products Co., St. Louis, Mo., has named John B. Ives vice president in charge of production.

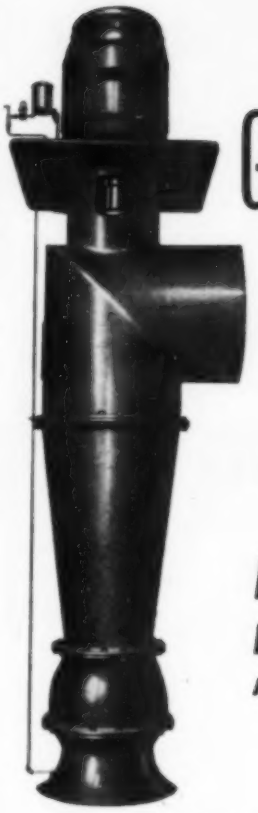
Engineering Associates, Inc., St. Charles, Ill., has announced a change in management. The corporation has been purchased by and will operate under the direction of Foster W. Berry, president, P. A. M. Palese, vice president and John J. Jaeger, secretary and treasurer.

Bemis Bro. Bag Co., St. Louis, Mo., has appointed R. N. Barksdale to assume new sales duties at the Memphis sales division.

Glenn L. Martin Co., Chemicals division, Baltimore, Md., is the new name of the Glenn L. Martin Co.'s Plastics and Chemicals division.

E. I. du Pont de Nemours & Co., Inc., Wilmington, has announced the new retail products division of the Grasselli Chemicals department under Joseph A. Jenemann, manager.

Witco Chemical Co., New York, has started construction of an asphalt



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CAPACITIES: UP TO 220,000 G.P.M.
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Rapidly Move and Remove Vast Volumes of Water Against Low and Medium Heads

Highly successful in the efficient handling of large volumes of water, Peerless Mixed Flow Pumps are being applied to process work, condenser service, liquor and chemical circulation, and a variety of industrial services where pumping is desired from open pits, sumps, and surface water sources, such as lakes, rivers, etc. and for large scale dewatering operations.

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Water turbulence accompanying the usual propeller and vane construction, and normally resulting in excess wear, inefficiency and loss of power, are reduced to the minimum in the Peerless Mixed Flow design.

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Peerless Propeller Type Pumps

Peerless pumps, embodying the Hydro-Foil principle, are available in the propeller type and are capable of handling identical capacities of the Peerless Mixed Flow pump. Request Bulletin B-148 completely describing the design, construction and application data of these two types of Peerless Pumps, for large-volume water pumping.

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Study the properties of Du Pont polythene. Its unusual inertness to chemicals including solvents, its toughness, its light weight, its ready workability may provide the answer to your material problems. Write for specific data. E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Room 101, Arlington, N. J.

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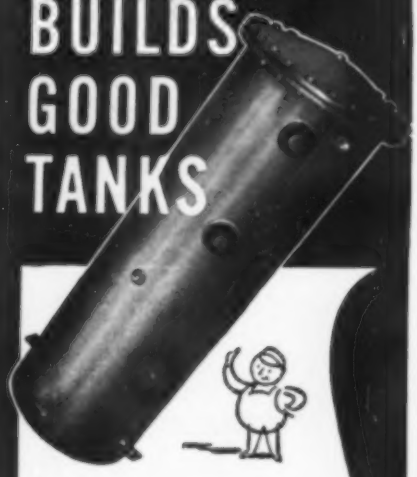
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

LITTLEFORD BUILDS GOOD TANKS



To your specification—any size, any shape, any metal—*any time*. Skill and knowledge of 65 years is yours at Littleford in plain, storage, mixing and ASME pressure tanks. Our Engineering Service can be very helpful. Tell us what you need.

LITTLEFORD

LITTLEFORD BROS., INC.
428 E. Pearl St., Cincinnati 2, Ohio

processing refinery in Perth Amboy, N. J. The plant will be in operation by the middle of this year.

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has named Harry A. Wright engineer in charge of control sales of the electrical department.

Hercules Powder Co., Wilmington, has named Charles H. Gant manager of ethyl cellulose promotion. William H. Morrison succeeds him as manager of the Parlin, N. J., plant.

H. K. Ferguson Co., New York, has appointed Gerald Wilson manager for the Eastern district.

Pennsylvania Salt Mfg. Co., Philadelphia, has appointed William J. Hennessy Pittsburgh district sales manager.

Givaudan-Delawanna, Inc., New York, has formed the Sindar Corp., a separate company to take over activities of industrial products division. The main office is in New York. Branch offices are in Chicago, Los Angeles, Philadelphia, Cincinnati, Detroit, Seattle and Boston. It is represented in Canada by Stuart Brothers, Ltd. of Montreal and Toronto.

Hydraulic Press Mfg. Co., Mount Gilead, Ohio, has elected Walter G. Tucker chairman of the board. Paul C. Pocock, will assume active direction of operations as executive vice president and general manager. Warren R. Tucker was elected vice president in charge of engineering and research.

Barrett-Cravens Co., Chicago, has formed a new West Coast subsidiary known as Heimer Equipment Co., 1247 48th Ave., Oakland, Calif., to be exclusive distributor for the complete Barrett line of lift trucks and related equipment. Mr. Heimer, who will continue as president of Barrett-Cravens Co., will be assisted in the West by his son, a graduate engineer.

Tennessee Eastman Corp., New York, has announced the distribution of Eastman Acetate Dyestuffs in Canada will be handled exclusively by Clough Dyestuff Co., Ltd., 33 St. Mathieu St., St. Laurent, Quebec.

American Brake Shoe Co., New York, has appointed Charles S. Sliter assistant general sales manager for the Kellogg division.

Owens-Illinois Glass Co., San Francisco, has appointed Huntley Castner as assistant Pacific Coast sales manager of the glass container division.

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Mines: New Gulf, and Moss Bluff Texas

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"Vibra-Flow"

DRY FEEDER MACHINES

with vibrated, non-arching hoppers

are Complete Units for the

CONTROLLED FEEDING

of dry, bulk materials to processing machinery.

Supply hopper equipped with SYNTRON electro-magnetic Vibrator to assure a free flow of material to the "Vibra-Flow" Vibratory Feeder which in turn controls the flow of material.

They can be scale-controlled in filling large or small containers to weight, or controlled by pH indicators, venturi meters, etc.

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SYNTRON CO.

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CONVENTION PAPER ABSTRACTS

CONTENTS

Nucleonics Bandwagon 256
Nicotine by Ion Exchange..... 258
Continuous Production of P..... 258
Fusion, Not Fission..... 260
Science Policy for Germany..... 260
Process Instrumentation 262
Flexible Phenolics 264
The Lowly Kettle..... 264
Petroleum Formation Theory..... 266
Know Your Competition..... 268
Vanishing Insecticide 268
Hydrocol Chemicals 270
Happy Thought 272
Statistical Control 272
Multum ex Parvo..... 274
Paint From Petroleum..... 276

Get on the Nuclear Bandwagon

ANY corporation which expects to be doing business 25 years from now must keep in touch with atomic progress because nuclear research under way in the nation's laboratories today will change the pattern of industrial operations tomorrow. All industry has a stake in the atom, but thus far only a few farsighted corporations have invested in the future of atomic energy.

The majority of American industrial leaders is in the dark as to the possibilities of the atom because of three basic misbeliefs:

1. That atomic energy is a government monopoly.

2. That the benefits of atomic energy will be postponed indefinitely because of technical difficulties.

3. That only a few specialized industries can possibly be benefited by atomic developments.

Already, more than 1,000 industrial possibilities of radioisotopes have been catalogued. Their principal value lies in their unique ability to show how processes take place. If industry wants to know why anything is what it is, radioisotopes can help. Thus, in some respects, all industrial problems are linked to the field of atomic research and are affected by it. How can industry participate in these developments? Easiest and most inexpensive method is to discover the two or three universities which are leaders in atomic research and arrange to participate in their work. As an example, the University of Chicago has inaugurated a system of industrial memberships in

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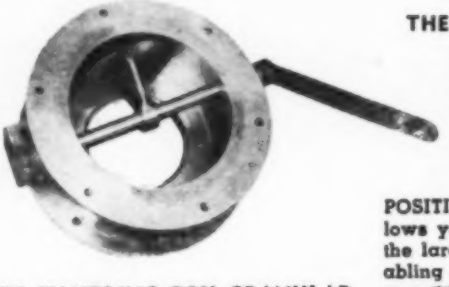
"GEMCO" SPHERICAL VALVES

DEFIES TROUBLE!

Constructed in various metals suitable to service requirements.



THE "GEMCO" SPHERICAL VALVE is a non-sifting and non-sticking water tight closure, which operates easily. The ground disc, by its superior action, cuts sharply thru materials and scrapes the seat clean as it closes. A quarter turn closes and seats the valve POSITIVELY. This quick acting device allows you to open or close, to any degree, the largest or smallest valve instantly, enabling the operator to measure out definite quantities.

IN HANDLING DRY GRANULAR OR PASTY SUBSTANCES.

For pipe lines, hoppers, bins, blender installations and for replacing troublesome slide-gates.

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Pharmaceutical firms find this valve, in stainless steel, a valuable aid in combatting contamination.

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Special Chemical and Mixing Machinery

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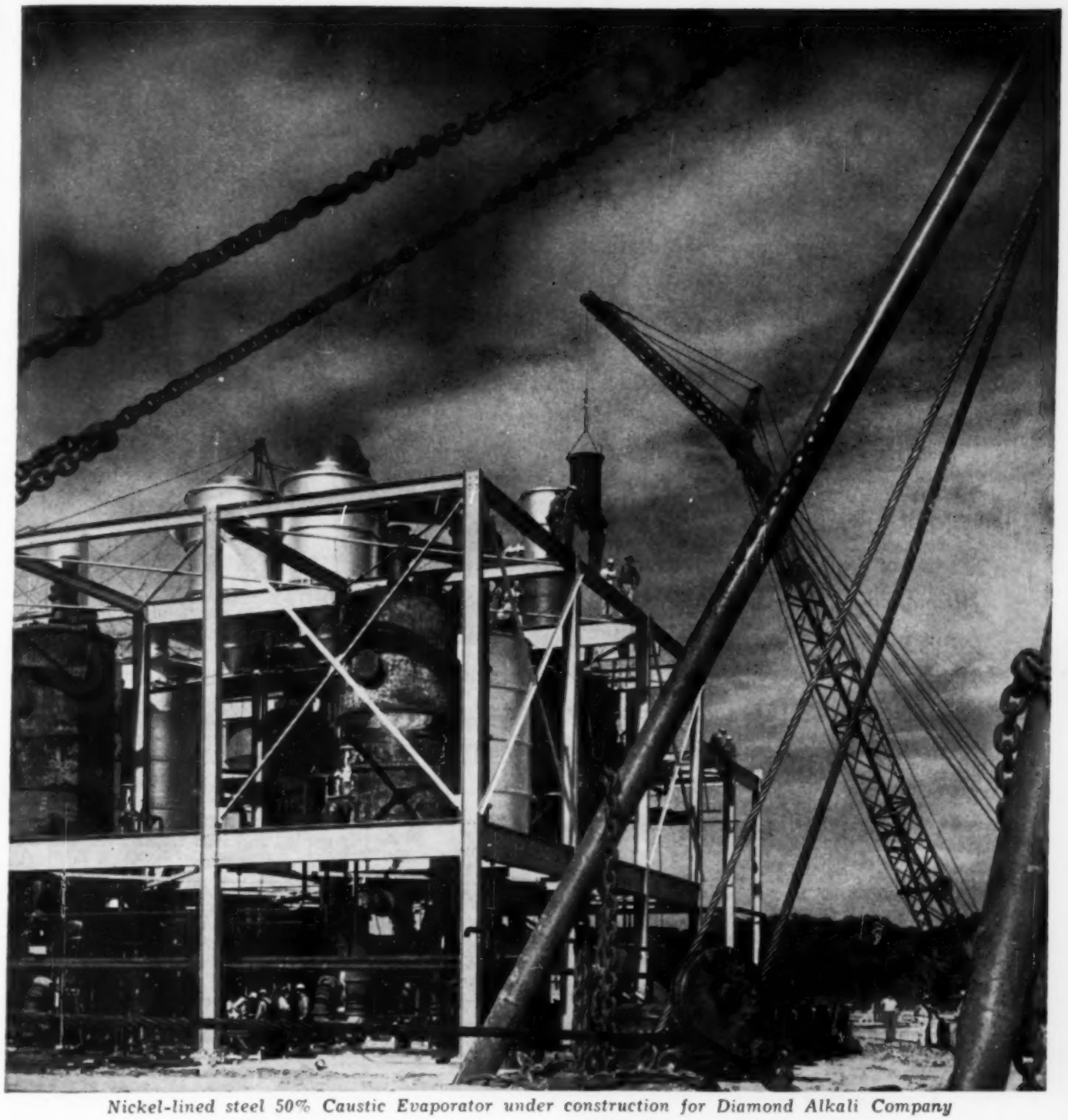

Nickel-lined steel 50% Caustic Evaporator under construction for Diamond Alkali Company

The $12,000,000 Diamond Alkali Job

BROWN & ROOT, Inc.

Chemical plants, such as the Houston Works of the Diamond Alkali Company, are a specialty of Brown & Root, Inc. We are engineering and erecting this vast and ultra-modern plant and will deliver it in production of caustic soda and chlorine. *Thanks to Industrial & Engineering Chemistry for this picture, which they used as a front cover illustration*

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There's extra service — extra efficiency — in stirring equipment that's "made to order". NETTCO Agitators, specially designed and built for your particular use, are tops in performance. They are engineered as complete units in gear ratios from 1 to 2000 and speeds from ½ to 1750 R.P.M. to best suit operating conditions. NETTCO's use of standardized parts and units provides "custom-built" equipment at low cost.

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Special Agitator
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its $12,000,000 program of atomic research. For $50,000 a year the industrial members can be in direct touch with some of the world's outstanding scientists now at work in the university's institute for nuclear studies, institute of metals and institute of radiobiology and biophysics.

Robert M. Hutchins, University of Chicago, before National Association of Manufacturers, New York, Dec. 5, 1947.

Nicotine out of Dust By Ion Exchange

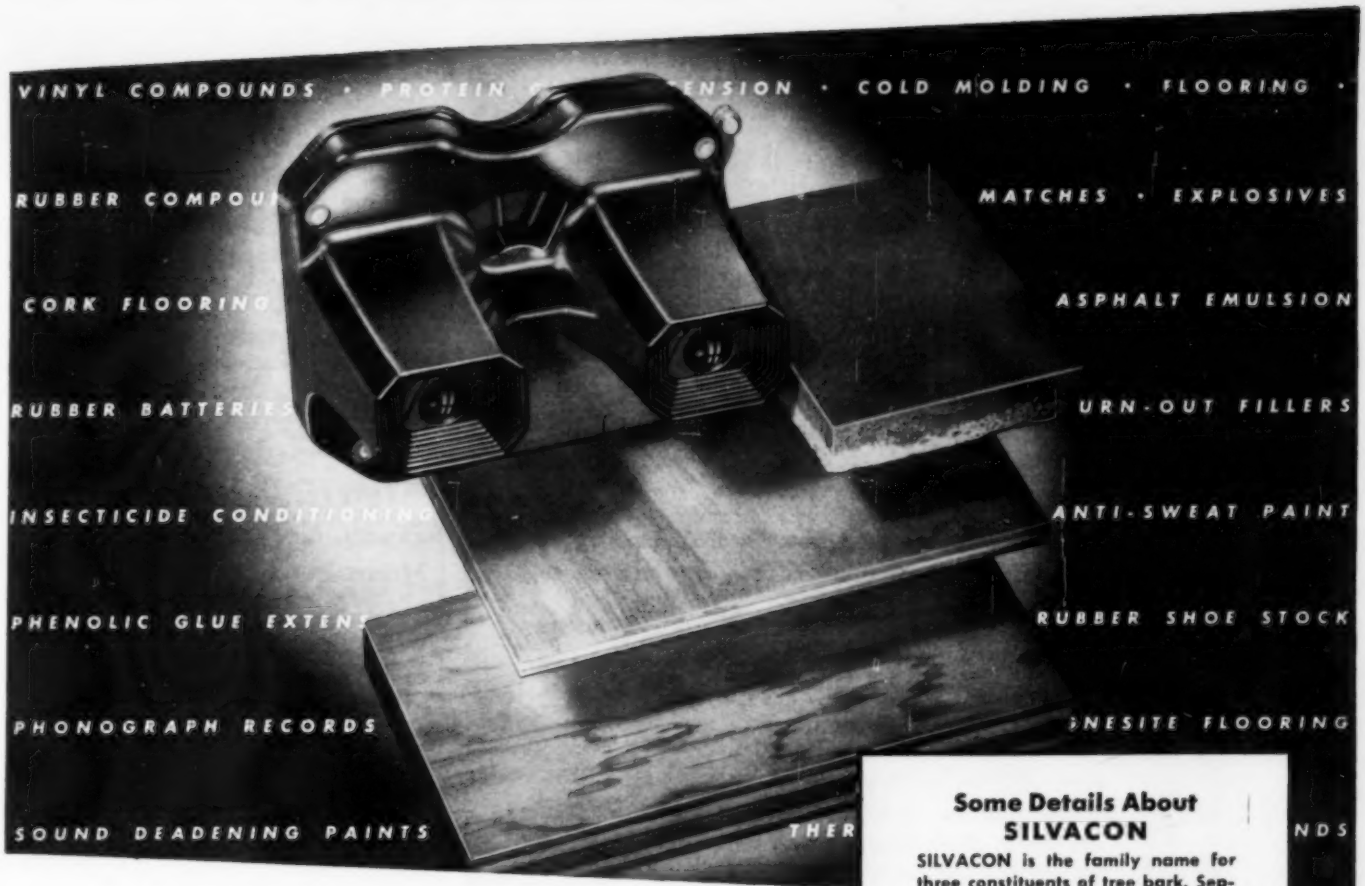
IN CIGARETTE manufacturing, tobacco is redried before manufacturing operations, and the hot air from the dryers has a small amount of nicotine present. By scrubbing these gases with water, the nicotine is dissolved out of the air, and by passing the scrubbing water through ion exchange materials, the nicotine is selectively removed.

Though the chemical engineering operation of ion exchange is well-known, new ion exchange materials and processes are being discovered every day, and the removal of nicotine from the dryer exhaust gas is an example of the minute quantities of chemicals it is possible to separate by this operation. Though the amount of nicotine in the tobacco leaf is only 2 to 8 percent, one installation is recovering 175 lb. per week of this valuable material from a factory drying 100,000 lb. of tobacco. By chemically treating the ion exchange materials, efficient recoveries of nicotine are obtained, and after its removal, the ion exchange materials are again put back into operation on another cycle.

A. W. Kingsbury, A. B. Mindler and M. E. Gilwood, the Permutit Co., before American Institute of Chemical Engineers, Detroit, Nov. 11, 1947.

Continuous Production of Red Phosphorus

A CONTINUOUS process for the production of red phosphorus developed in the laboratories of the Tennessee Valley Authority shortens the time required for conversion of white phosphorus to red phosphorus from days to hours over the commercial batch process. During the war a pilot plant embodying the continuous process was built and operated to produce red phosphorus of high purity for the War Department. In this process liquid white phosphorus is maintained continuously at its boiling point in a reaction vessel with a retention period of 5 to 6 hr., which converts from 30 to 50 percent of it to solid red phosphorus. The resulting slurry overflows continuously into a heated screw con-



A BETTER PRODUCT of uniform quality at a lower cost... is now possible by the use of Weyerhaeuser SILVACON

WHAT SILVACON IS: Silvacon is a family of ingredients freed from tree bark, a previously untapped source of raw material. Silvacon fractions — cork particles, hard fibers, amorphous powder — are recovered by new manufacturing methods perfected by Weyerhaeuser.

WHAT IT DOES: A few of Silvacon's proved industrial uses — *Plastics* compounded with Silvacon meet quality specifications at reduced material costs; Silvacon extends *phenolic resins* to new limits, producing lower cost glue lines and binders; blends *insecticide dusts* with greater speed, dependable accuracy; increases wet strength of *magnesite flooring*; adds resiliency to *asphalt floor* emulsion compounds; lowers material costs of quality *rubber compounds*. Silvacon is being tested for application in many and varied fields.

WHAT IT MEANS: Silvacon opens untold opportunities for manufacturers and processors to make better quality end products at lower cost. Learn about this product so basic that its variety of uses is certain to have valuable applications affecting your business or profession.

Some Details About SILVACON

SILVACON is the family name for three constituents of tree bark. Separately they are: SILVACON 383, flake-like particles of cork, similar to Mediterranean oak cork; SILVACON 508, finely fractionated hard dense lignified fiber; SILVACON 490, powdered amorphous material. In addition, there are SILVACON 412, a combination of cork and fiber, and SILVACON 472, a combination of cork, fiber and powder.

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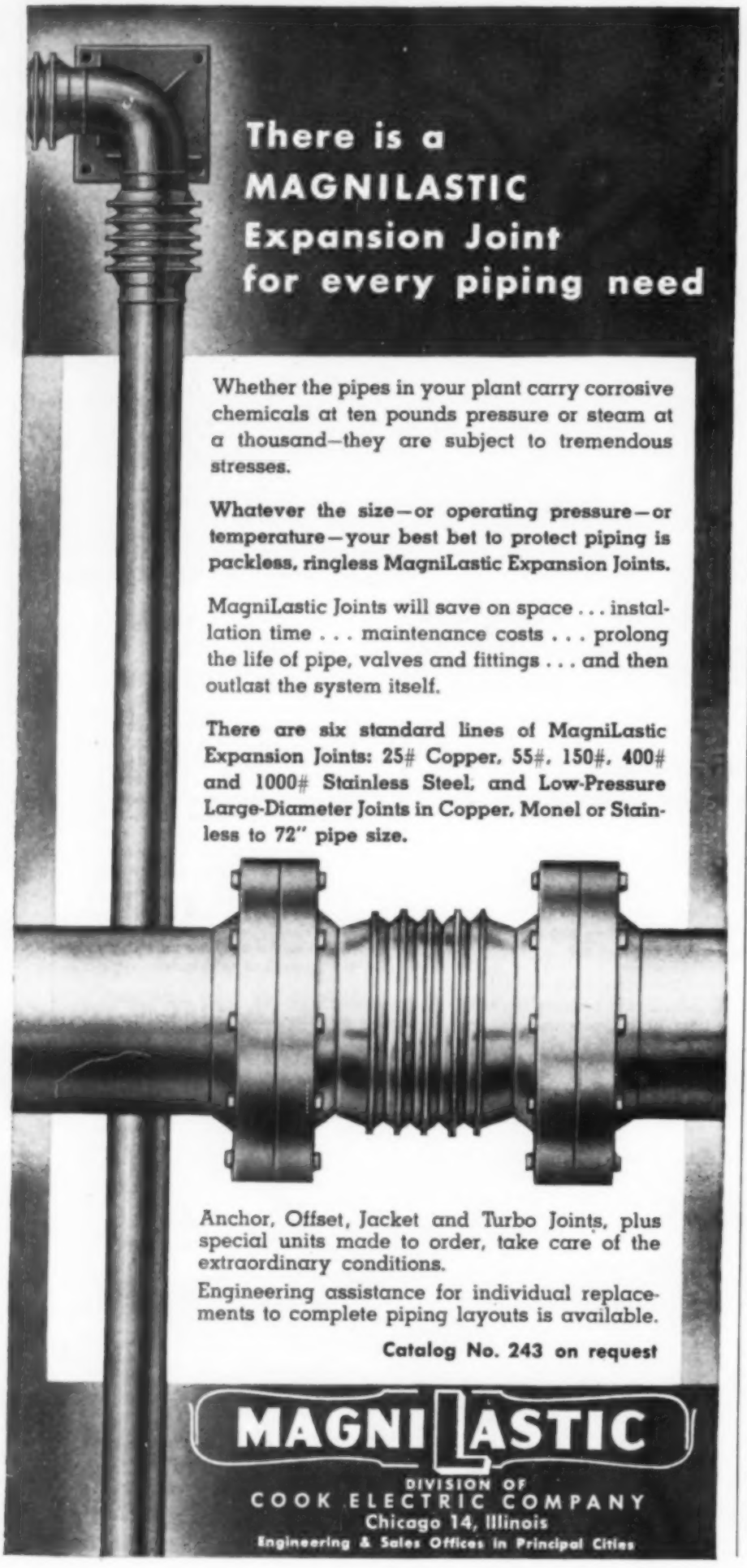
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veyor in which it is carried countercurrent to a stream of hot inert gas. The white phosphorus is vaporized and carried to a condenser, to be collected and recycled. Finely divided red phosphorus is discharged as the product and does not require treatment with boiling caustic or grinding, as in the batch process. An additional advantage of the continuous process is its suitability for production of a product of high purity, needed in certain military applications.

Philip Miller, R. A. Wilson and J. R. Tusson, TVA, before Division of Industrial and Engineering Chemistry, American Chemical Society, New York, Sept. 18, 1947.

Fusion, Not Fission, Means Power

Atomic fusion, the reverse of atomic fission, could produce ten times the power obtained by splitting uranium. A chain reaction of the fusion type, which would free surplus energy by uniting the nuclei of small atoms, would be an even more perilous source of power than nuclear fission, because it would involve the lighter, more abundant elements and therefore would be far more difficult to control.

Although the possibility of achieving a chain reaction of this kind appears remote just now, science has only begun to tap the immense reservoirs of energy locked in the atom. In fact, despite the enormous power generated by existing nuclear piles, science up to now has succeeded in converting only one-thousandth of the total mass of uranium into energy.

Samuel C. Lind, University of Minnesota Institute of Technology, Southwest Regional Meeting, American Chemical Society, Houston, Dec. 19, 1947.

The Policy for Controlling German Scientific Work

Although research represents a real war potential, and must be carefully controlled, we Americans have a responsibility for fostering German research. This responsibility should be taken by private groups and individuals in the United States, and not by the American military government's adopting a more paternalistic attitude. The recovery of German science will be slow in any event, but true recovery would be slowed still more if we changed our government policy of letting the Germans do for themselves.

The American policy for controlling German scientific work puts first responsibility for enforcement of the law upon the German governments, while retaining complete authority to step in when necessary.

Scientific research has a dangerous

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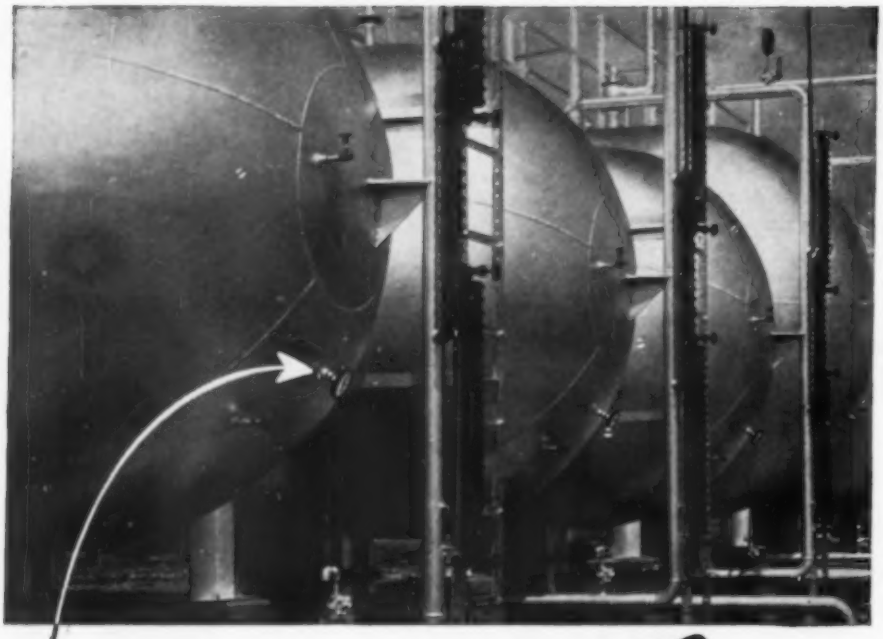

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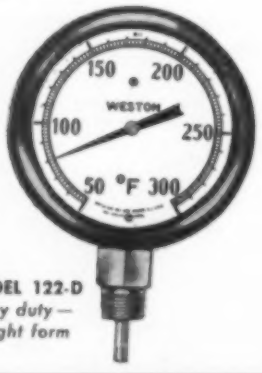


MODEL 122-D
heavy duty—straight form

MODEL 222-D
heavy duty—angle form

war potential, and the Russians and French fear the resurgence of German militarism. In every country, special interests are exerting pressure to use this fear to prevent rebirth of German competition.

German research is controlled but not crippled by the American law. Research can be carried out only in an institution licensed by the Military Government, and a report must be made every four months giving all changes in personnel and progress on each research project. Then research is divided into two categories, fundamental and applied. Applied research in fields of a high military potential is forbidden. Applied research in fields which have a military potential, but which are important to the industries permitted in Germany, require prior permission from the military governor. Other applied research requires prior notification to the military governor. Any fundamental research is permitted except that "of a wholly or primarily military nature."

George Scatchard, Massachusetts Institute of Technology, before Division of Physical and Inorganic Chemistry, American Chemical Society, New York, Sept. 17, 1947.

Instrumenting Continuous Processes

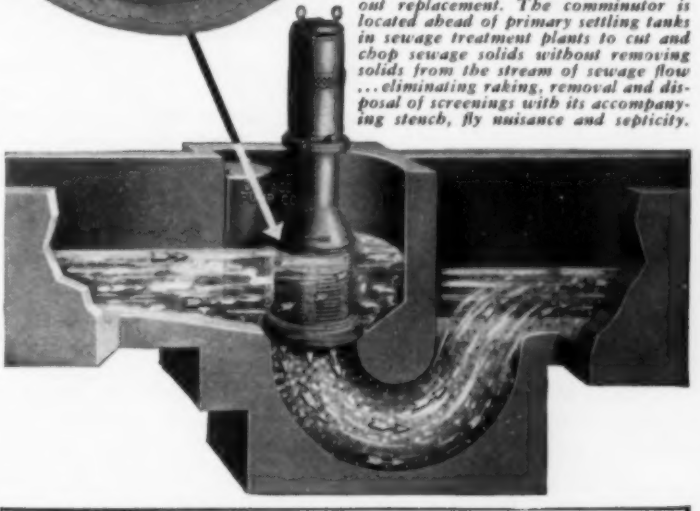
PROCESS engineers strive to simplify processes by reducing the number of operations and finding ways to substitute continuous for batch operations. Continuity results in higher product quality and uniformity, higher production rates per dollar invested, lower operating costs and lower process materials inventory. Instrumentation has greatly contributed to gains toward continuity in the last ten years. It constantly becomes more evident that instrumentation is a fundamental part of process design.

Careful study should be given to the location of the instrument control room in a manufacturing plant and to the arrangements of instruments on the control panels. Sufficient additional indicated or recorded information should be provided on the panels to permit the operator to have a clear picture of the operation of his entire process at all times. It is particularly important that "start-stop" stations be provided on the panels for all important pump motors and that the need for interlocks be considered.

The extent to which the operation of such process equipment items as vacuum filters and centrifuges is made automatic or semi-automatic will be governed by the nature of the materials handled, the design of the equipment items, their importance in the process, and the economics of

Meet an Alloy Iron that COMBATS CORROSION WEAR AND GENERAL ABUSE

The revolving drum and other corrosion resisting parts of the Chicago Pump Co.'s Comminutor are cast in Types 1 or 2 Ni-Resist by the Sterling Foundry Co., Wellington, Ohio. Many of these Ni-Resist drums have served for ten years or more without replacement. The comminutor is located ahead of primary settling tanks in sewage treatment plants to cut and chop sewage solids without removing solids from the stream of sewage flow ... eliminating raking, removal and disposal of screenings with its accompanying stench, fly nuisance and septicity.



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Lower your maintenance expenses with Ni-Resist by taking advantage of its extra resistance to corrosion, wear and abrasion ... and at moderate cost.

RELATIVE RATE OF CORROSION OF CAST IRON AND NI-RESIST IN TESTS AT CLEVELAND, OHIO, SEWAGE PLANTS

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Condition	*Cast Iron*	*Ni-Resist*
Exposed in screen house to fumes from raw sewage for 279 days	100	23
Exposed in screen house to fumes from raw sewage containing chlorine for 278 days	100	57
Exposed to rapidly flowing raw sewage in trunk sewer feeding Imhoff Tanks for 278 days	100	11
Exposed in gas chamber of Imhoff Tank to partially digested sewage for 278 days	100	0.7

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manual vs. automatic operation. It is essential that the instrument and design engineers work together until the design and layout drawings have been completed. Careful follow-through during the installation period and an adequate, preventive maintenance program will assure profitable results.

H. C. Frost, Corn Products Refining Co., before Short Course on Instrumentation, Texas A. & M. College, College Station, Tex., Aug. 27-29, 1947.

Phenolic Resins Blended With Synthetic Rubber

PHENOLIC resins have for many years served useful and decorative purposes in every-day living. Primarily their applications have been in rigid or semi-rigid structures, such as electrical housings, cabinets, laminates, etc. Their fields of application have been limited by lack of flexibility, tear strength, and impact strength.

Modification of the resins to correct for these shortcomings has been difficult, since they are either incompatible with general modifying plasticizers or are adversely affected to the extent that their inherent attractive properties are destroyed.

By blending phenolics with synthetic rubber Perbunan NS, new and attractive properties can be imparted to the resin, including color, flexibility and improved impact strength. It also has been discovered that the S-polymers, new and interesting thermoplastic saturated hydrocarbon resins derived from petroleum, show unique advantages blended in phenolics. They improve the processability, and tear strength. Artificial leathers fabricated from such blends would possess long service life, flexibility, and great strength.

It is believed that this work demonstrates only a few of the many outstanding possibilities in this field. However, it points the way to new and improved products stemming from those closely related industries—rubber and plastics.

R. G. Newberg, D. W. Young, Standard Oil Development Co., and W. A. Fairclough, Enjay Co., before Paint, Varnish and Plastics Division, American Chemical Society, New York, Sept. 17, 1947.

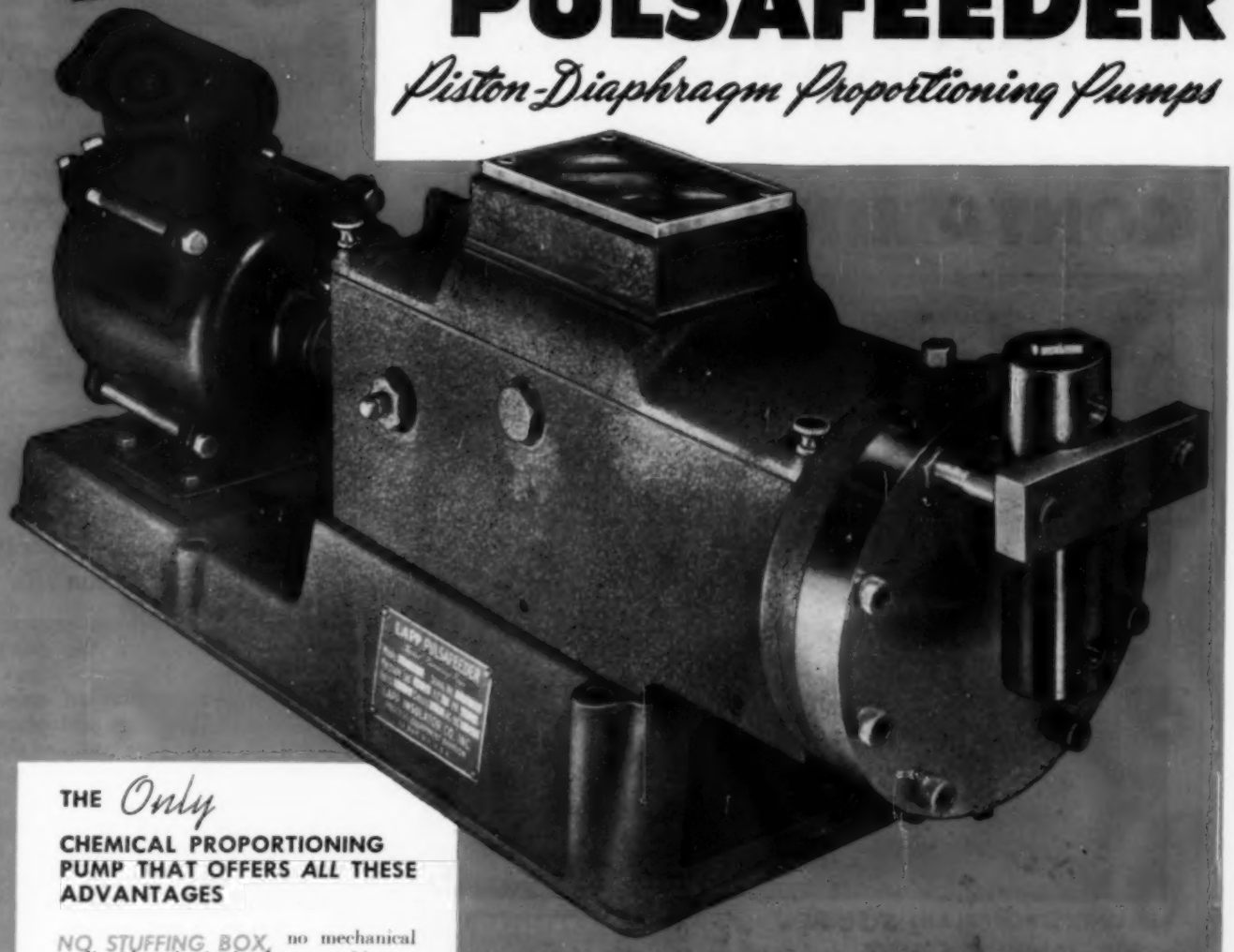
Lo, the Lowly Kettle

ONE of the most fundamental and versatile units of processing equipment available to the chemical engineer is the processing kettle. Frequently when such equipment is contemplated, not sufficient emphasis is placed upon its versatility and full possibilities in the process.

Its versatility lies in the fact that it can be used for such unit operations as

NEW *Lapp* PULSAFEEDER

Piston-Diaphragm Proportioning Pumps



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CHEMICAL PROPORTIONING PUMP THAT OFFERS *ALL* THESE ADVANTAGES

NO STUFFING BOX no mechanical or liquid seal, absolutely no packing or other "leak-likely" gland can be in contact with liquid being handled.

CHEMICAL ISOLATED by diaphragm from working parts of pump.

NO CONTAMINATION. Product is protected from lubricants and from contact with atmosphere.

MICRO-ADJUSTABLE to any rate of flow by calibrated handwheel, while pump is in operation.

PERFECT LUBRICATION with all moving parts submerged in oil bath.

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No changes in composition of material during its handling in the plant.

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heating, cooling, mixing, extracting, reacting, distilling, evaporating, drying or for solvent recovery operations, each under vacuum, atmospheric or pressure operations.

Its possibilities are that several of these unit operations can be carried out, or even a complete processing operation involving several of them, in the same piece of kettle equipment.

It is recognized that other types of equipment may effectively handle a processing step, but in view of current costs of unit pieces of equipment, labor for operation, and of transfer of materials between pieces of equipment, it becomes increasingly economic to consider the use of a multipurpose unit, such as the processing kettle, to perform several operating steps in the same equipment, and many new processing developments are proceeding along these lines.

A. W. Johnston, Buflovak Equipment Division, Blaw-Knox Co., before Northern California Section, American Institute of Chemical Engineers, San Francisco, Oct. 22, 1947.

More on Radioactivity Theory Of Petroleum Formation

RECENTLY, it has been proposed that bacterial action or the energy from the high-speed particles released by radioactivity may play an important role in converting protoplasm, proteins, fats, and other complex substances into the constituents of crude oils. Since radioactive conversion was first proposed about twenty years ago, research has shown that there may be sufficient radioactivity in the materials of oil fields to effect this conversion over a period of ten million to one hundred million years.

Paraffinic or straight chain hydrocarbons, which compose a significant part of petroleum, can be produced by irradiating, with alpha particles or deuterons, certain fatty acids known to exist in source sediments. Likewise a cycle or ring paraffin has been produced from a cyclic acid.

Hydrogen was usually the major component of the gaseous products of these bombardments. Since this gas is found only in minute quantities in natural gases associated with petroleum the theory that radioactivity plays a role in petroleum formation has been subject to some criticism.

Although it has been proposed that hydrogen could disappear to the atmosphere by diffusion, it seemed likely that the unsaturated compounds in source sediments, that is those not having their full complement of hydrogen, might be hydrogenated under the influence of radioactivity and thus absorb at least part of the hydrogen.

Oleic acid, an unsaturated fatty acid,

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Talk to the Kidde representative, too, about other fire hazards in your plant. You may gain some helpful ideas from his thorough knowledge of fire protection problems and extinguishing equipment.

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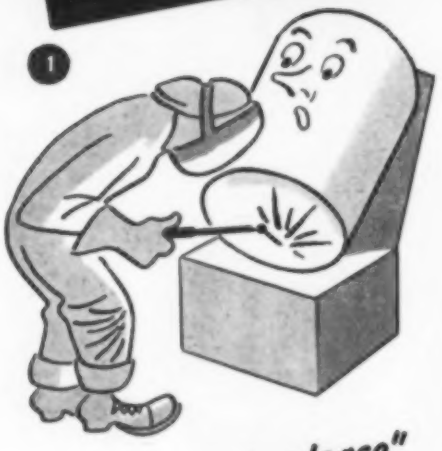

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(1) Not too much heat — not too little in the welding arc! Stainless steel is tricky to fabricate. Our experienced welders know that improper welding temperature reduces corrosion resistance at the seams. Blickman-controlled welding procedures give you sound, corrosion resistant welds.

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was, therefore, bombarded with deuterons in the MIT cyclotron. Evidence of hydrogenation was obtained through the isolation of 3 percent of stearic acid, the saturated acid corresponding to oleic acid.

In addition, the unsaturated hydrocarbon heptadecene-8 was produced by the decomposition of oleic acid into this hydrocarbon and carbon dioxide. This fact is extremely interesting since there is no evidence in the literature that this compound has been prepared in pure form by chemical means.

These changes in organic compounds have been brought about by bombardment or radiation under laboratory conditions. Whether similar conversions may take place in the organic material present in oil fields to form appreciable quantities of petroleum is as yet unknown. The radioactivity of earth materials is now being measured and in time, as this study progresses, some definite idea will be obtained as to the quantitative importance of radioactivity in the formation of crude oil.

Virginia Burton, Massachusetts Institute of Technology, before Organic Division, American Chemical Society, New York, Sept. 18, 1947.

Know Your Competition

ONE of the outstanding requirements in any organization is to know where it stands in comparison with its competitors in a given field of distribution. Competitive studies should be arranged for the management showing them what percentage of the market they have and also what percentage goes to their competition, in detail and by name. Competition is a governing factor in any business no matter how small or big. The greater your success, the greater effort is made by others to share it. Success comes about by attention to detail and at all times knowing your position on the sea of commerce. Fundamental principles of conducting a business are the same whether it be a peanut stand, a grocery store or a million dollar industry.

Luther D. Reed, E. I. du Pont de Nemours & Co., before American Society of Mechanical Engineers, Atlantic City, Dec. 4, 1947.

An Insecticide That Kills And Vanishes

THE GERMAN compound, hexaethyl tetraphosphate, which was produced as an offshoot of research on war gases, is now being manufactured on a large scale in the United States and is particularly useful against certain pests which do not succumb to DDT and other insecticides.

Chemical studies in the Department of Agriculture laboratories have re-

THE Sides OF A V-BELT

Diagram of V-Belt in Sheave-Groove

ARE WHAT

Grip the Pulley,

Pick-up the Load

AND REALLY

Get the Wear!

Every ounce of load a V-Belt carries must *first* be picked up by the *sides* of the belt. Clearly so, because *only* the *sides* come into contact with the pulley! The sides do all the *GRIPPING* on the pulley. They get all the wear against the sheave-groove wall. The sides *pick up* the load. They transmit that load to the belt as a whole. And then, once more, the sides—and the sides *alone*—grip the driven pulley and *deliver* the power to it.

That is why you have always noticed that the sidewall of the ordinary V-Belt is the part that wears out first.

THAT'S WHY THE Concave Side

(A GATES PATENT)

IS IMPORTANT TO YOU!

Clearly, since the sidewall is the part that wears out first, anything that prolongs the life of the sidewall will lengthen the life of the belt—and that's why the patented Concave Side is important to you.

The simple diagrams on the left below show exactly why the ordinary, straight-sided V-Belt gets excessive wear along the *middle* of the sides. They show also why the Patented Concave Side greatly reduces sidewall wear in Gates Vulco Ropes. That is the simple reason why your Gates Vulco Ropes are giving you so much longer service than any straight-sided V-Belts can possibly give.

and the CONCAVE SIDE is more important NOW than ever before!

Now that Gates SPECIALIZED Research has resulted in Super Vulco Ropes capable of carrying much heavier loads—fully 40% *higher horsepower ratings*—the sidewall of the belt is called upon to do even more work in transmitting these heavier loads to the pulley. Naturally, with heavier loading on the sidewall, the life-prolonging Concave Side is more important *now* than ever before!

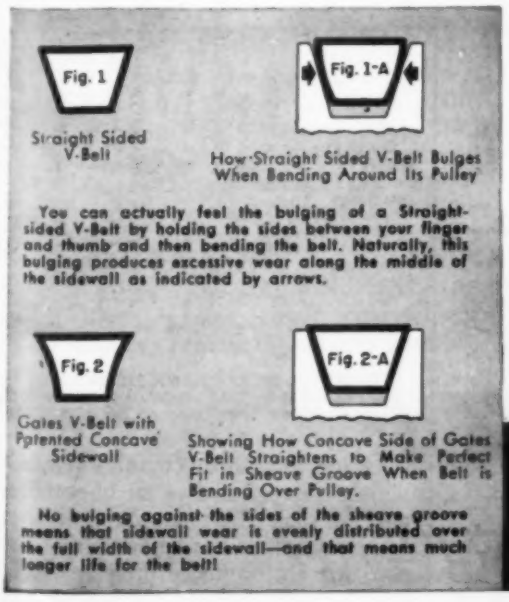
Fig. 1
Straight Sided V-Belt
Fig. 1-A
How Straight Sided V-Belt Bulges When Bending Around Its Pulley
You can actually feel the bulging of a Straight-sided V-Belt by holding the sides between your finger and thumb and then bending the belt. Naturally, this bulging produces excessive wear along the middle of the sidewall as indicated by arrows.
Fig. 2
Gates V-Belt with Patented Concave Sidewall
Fig. 2-A
Showing How Concave Side of Gates V-Belt Straightens to Make Perfect Fit in Sheave Groove When Belt is Bending Over Pulley.
No bulging against the sides of the sheave groove means that sidewall wear is evenly distributed over the full width of the sidewall—and that means much longer life for the belt!

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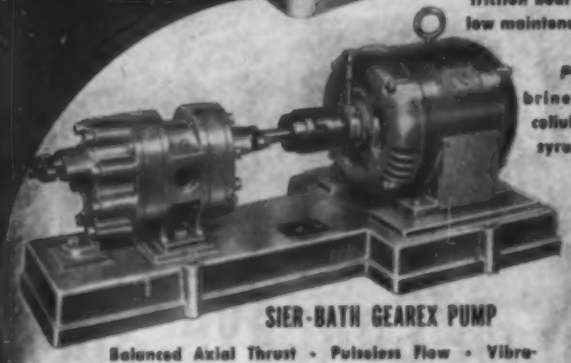
Advantages: • pulseless flow • anti-friction bearings • vibrationless operation • low maintenance cost • rugged construction.

Pumps: Acetate, asphalts, brines, Bunker C Fuel Oil, cellulosics, greases, molasses, syrups, lube oils, etc.



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vealed that the active ingredient of this German material is an even more powerful substance called tetraethyl pyrophosphate. Chemists of the Bureau of Entomology and Plant Quarantine have isolated the latter in pure form from the German product and have also prepared it by independent methods. They found that highly potent tetraethyl pyrophosphate decomposes in the presence of atmospheric moisture to diethyl orthophosphoric acid, a relatively non-toxic substance.

The rate of decomposition of the insecticide follows a definite law known as a first order reaction. Its half-life at a temperature of 77 deg. F. is 6.8 hr. On a hot summer day (100 deg. F.) its half-life is only 3.3 hr. It lasts long enough, however, to do an efficient job of killing certain agricultural insect pests. Because of its high toxicity, the gradual disappearance of the insecticide, after it has killed the insect pests, is a virtue.

S. A. Hall and M. Jacobson, U. S. Dept. of Agriculture, before Division of Agricultural and Food Chemistry, American Chemical Society, New York, Sept. 17, 1947.

Hydrocol Process as a Source of Chemicals

THE Hydrocol process has been developed primarily to augment the reserves of petroleum and to meet increasing demands for its products. However, this and similar processes will also become the principal source of many of the basic oxygen-containing organic chemicals, particularly those used in the cellulose plastics and acetate rayon industries.

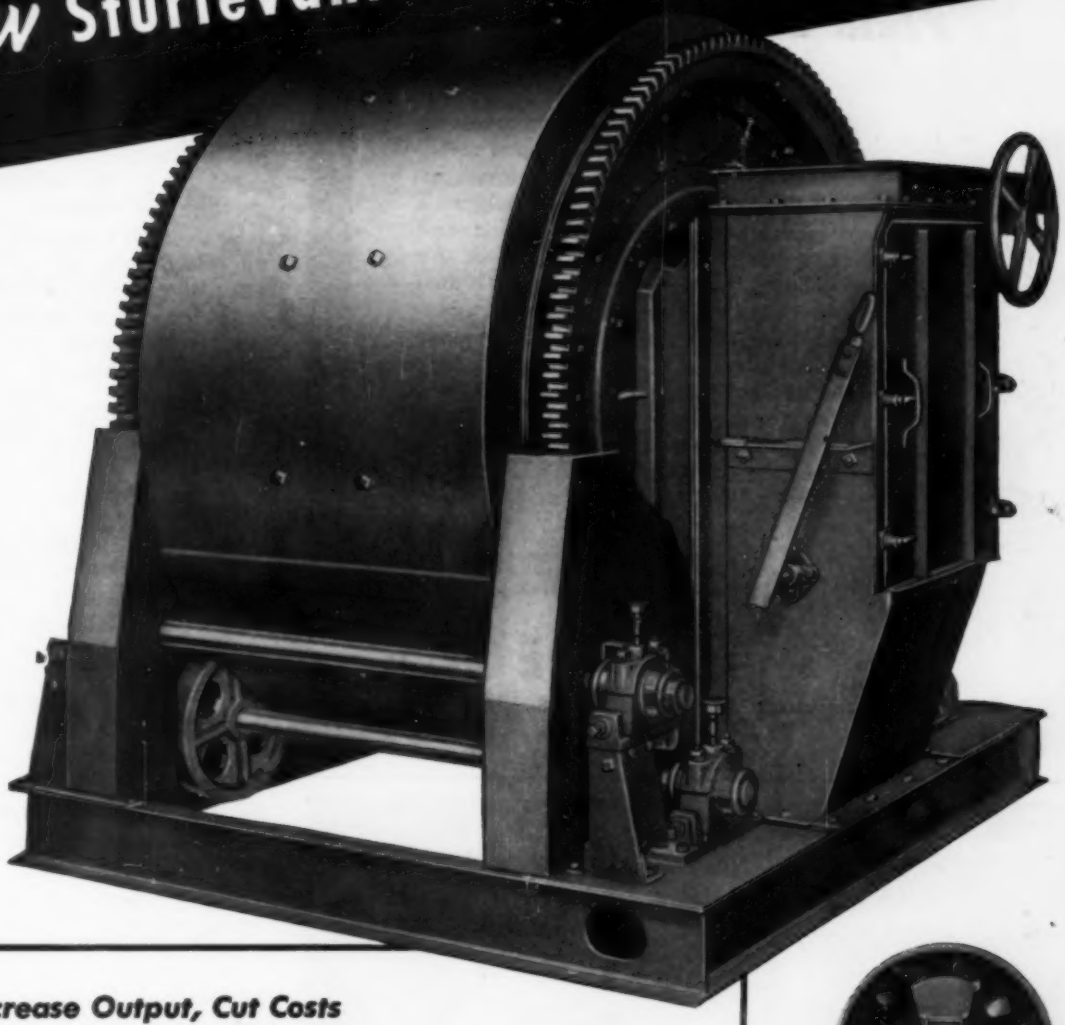
Principal Present Sources of Important Chemicals Produced by the Hydrocol Process

Company[6]	Acetaldehyde	Acetone	Methyl Ethyl Ketone	Ethyl Alcohol[1]	n-Propyl Alcohol	Isopropyl Alcohol[2]	Butyl Alcohol	Amyl Alcohol	Acetic Acid	Propionic Acid	Butyric Acid
Carbide		X	X	X		X	X		X		X
Du Pont	X				X			X	X	X	
Commercial Solvents		X[4]					X		X	X	
Niacet	X								X		
Publicker	X	X[3]					X		X		
Shell		X	X	X[5]		X					
Standard Oil (N. J.)		X	X	X		X					
Tennessee-Eastman	X	X							X		
USI		X[4]					X	X	X		

[1] Synthetic only. [2] Not a Hydrocol product. [3] Celanese has recently advertised some of these chemicals. [4] Fermentation. [5] 1948.

Of less than thirty organic chemicals which were of such vital importance and in such short supply that they were subject to allocation during the war, five are produced directly by the

New Sturtevant Dry-Batch Mixers



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★ ***Open-Door Accessibility Permits Fast, Easy Cleaning***

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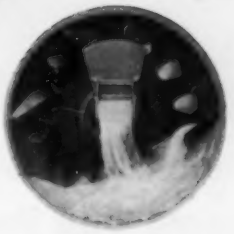
The mixer is simple and easy to operate . . . hand lever controls both receiving and discharging. These efficient Sturtevant dry-batch mixers are available in five sizes with mixing capacities from 7½ tons to 75 tons per hour. Write for bulletin and complete information today.



Receiving — The ingredients to be mixed enter the mixing chamber of the drum through a chute. Note scoops which carry up and dump the ingredients as the drum rotates.

Discharging — By simply throwing a lever, the inlet is closed and the mixer is in discharging position. The completely mixed materials drop off the lifting scoops and discharge through chute without segregation of ingredients.

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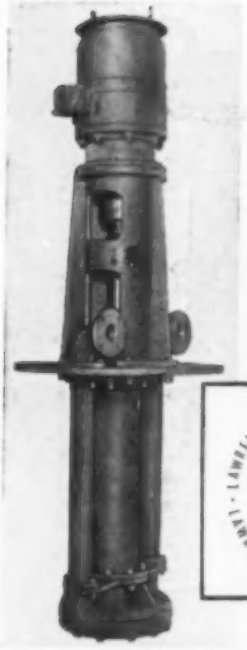

A newly-devised heating system circulates an abrasive-corrosive salt mixture at 850° F and even higher. To meet these tough requirements Lawrence engineers designed a vertical centrifugal pump with bearings and packing box outside the storage tank. An extra heavy shaft, in conjunction with dual opposed discharge outlets, minimize vibration and wear. All submerged parts are made of special alloys highly resistant to corrosion and abrasion of the hot mixture.

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Hydrocol process, three others can be produced exclusively from the primary products, and the primary products enter into the composition of four more. This development promises to be of great importance not only as a source of liquid fuels, but also because it will have a revolutionary effect on those parts of the organic chemical industry which make and use its organic chemical byproducts.

The point has been made that the present price of natural gas, in many cases 10c. per M, will limit the use of gas for fuel synthesis. It should be kept in mind that, while the nation's oil reserves are only sufficient for 12 years, the natural gas reserves are adequate for 32 years and much of this gas is located where it is not available for pipeline distribution.

Frederick W. Sullivan, Jr., consulting chemist, before Chemical Market Research Association, New York, Dec. 10, 1947.

Happy Thought

A MILLION people will be sacrificed in atomic warfare before scientists have an opportunity to save a thousand lives by research with radioactive isotopes produced in the atomic pile.

If the intellectual power that revealed the secrets of the atom were applied to establishing lasting peace, the human race would be spared from atomic slaughter, but indications are that the great nations are blindly stumbling toward the most destructive war of history.

Charles D. Coryell, Massachusetts Institute of Technology, before New York Section, American Chemical Society.

Statistical Control in Chemical Production

A SIMPLE technique assuring the purity and reliability of drugs, foods, plastics, and many other products has been developed through the use of statistical controls. A master chart that detects flaws and deviations in manufacturing processes is the key to the statistical technique. The chart helps maintain the quality of products and limit the cost of production.

Statistical quality control is being used in the production of such things as textiles, petroleum products, rubber, plastic materials, paper, organic solvents, food, pharmaceuticals, photographic materials, ferrous and non-ferrous metals, and heavy chemicals. It is being used to help set up specifications for raw materials; to help inspect raw materials; to help control chemical processes during manufacturing; to help evaluate the quality of final products; and to help develop better products at a lower cost.

The statistical technique does not

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replace time-tested methods of maintaining high quality, but supplements and improves them. First employed in the electrical and mechanical manufacturing industries, statistical controls were extended to chemical processes during World War II.

In order to maintain a check on a chemical process, groups of samples of the product are taken at regular intervals and submitted to the laboratory for analysis. The results of the tests are then plotted on a graph, or control chart. A set of limits, known as control limits, which have been set up on the basis of random variations of the process itself, are also posted on the chart. As long as the process continues to give satisfactory products, the tests results will continue to stay within these limits; but when the process gets out of control, the test results immediately begin to fall outside their control limits.

The value of the technique was illustrated during the manufacture of GR-S synthetic rubber. At one point in the production schedule, one step of the chemical process was altered slightly. The first batch of rubber made after this change was "out of control" with less ash than had ever been present in any batch up to that time. Without the aid of the control chart it would have taken many days to have proved that the change in the process had really resulted in rubber of better quality.

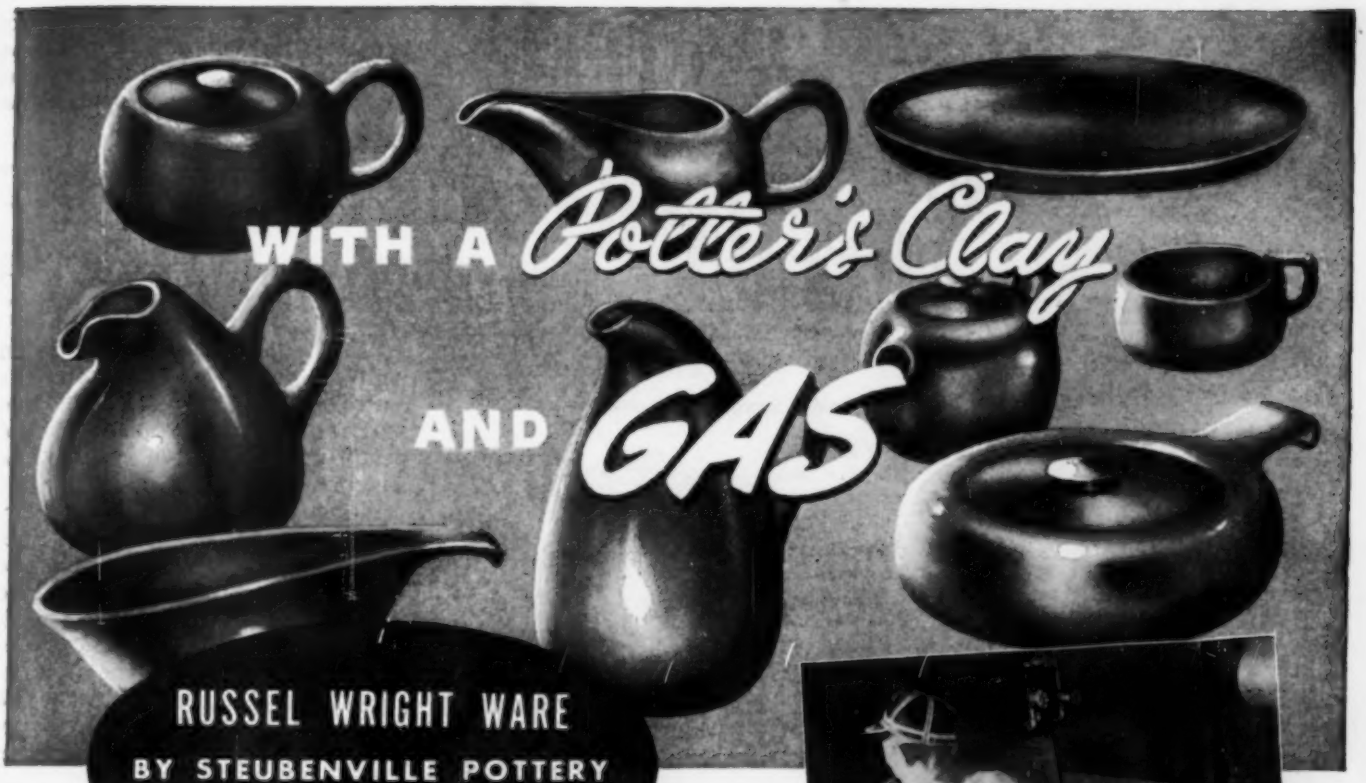
Another statistical tool that has proved useful in both the plant and the laboratory is known as variance analysis. This method makes it possible to determine simultaneously the effects of several factors upon a process. Variance analysis reduces to a minimum the number of chemical tests that must be made and also makes it virtually impossible to overlook any important factors. The method serves as a valuable guide in designing series of experiments.

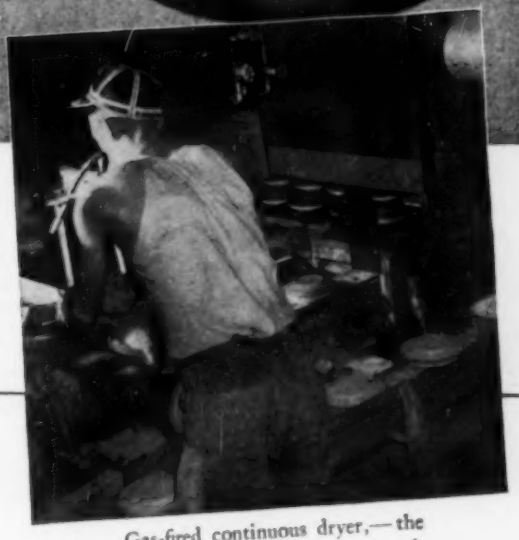
G. Wernimont, Eastman Kodak Co., before St. Louis Section, American Chemical Society, St. Louis, Oct. 6, 1947.

Multum ex Parvo

SCIENTISTS have found, to their surprise, that atomic bombardment of a substance, such as a petroleum compound, yields only a limited number of end products. The fact that such bombardment produces relatively large amounts of a few specific substances, instead of small quantities of many materials, indicates that atomic processes are suitable for controlled commercial applications.

In the atomic piles of the future provision will be made for use of radiations in new chemical processes. New materials, low-temperature crack-





Gas-fired continuous dryer,—the conveyor belt is loaded at this end.

True—this fine pottery contains chemicals and coloring, includes other ingredients, but at Steubenville Potteries GAS is the production-line fuel for continuous cycle heating operations, is just as important as the potter's clay in fine ceramic manufacturing.

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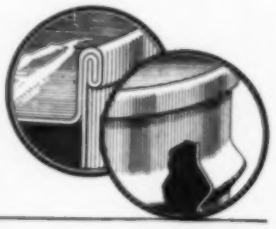

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ing of petroleum oils, and more effective chemical utilization of some natural resources now inefficiently employed are among the benefits to be expected.

Milton Burton, University of Notre Dame, before Iowa Section, American Chemical Society, Iowa City, Dec. 9, 1947.

Petroleum, a Basic Raw Material For Surface Coatings Industry

ALMOST unbelievable advances in petroleum technology itself over the past ten or fifteen years have done much to enhance the potentialities of petroleum as a surface coatings raw material.

Formaldehyde is a simple highly reactive organic compound. As a result of this high reactivity and low molecular weight (30), formaldehyde is a powerful and economical "building block" in synthetic organic chemistry. Formaldehyde may be manufactured by the partial oxidation of natural gas components under carefully controlled conditions. Formaldehyde may also be prepared from petroleum by a more circuitous route. A hydrocarbon is oxidized to produce carbon monoxide and hydrogen and this gas mixture is treated catalytically at high temperatures and pressures to form methanol which is partially oxidized to produce formaldehyde.

Most important reaction of formaldehyde, as far as the present discussion is concerned, involves the interaction of a formaldehyde molecule with an active hydrogen atom or atoms from one or more foreign molecules. In the aliphatic series, a hydrogen atom is very reactive when attached to a carbon atom which also bears one or more of certain groups, for example, the carbonyl group, the cyano group, the nitro group and the like. Such active hydrogen atoms are, in most cases, capable of reacting with formaldehyde to form a variety of compounds depending upon the extent to which the reaction proceeds. In the simplest case, formaldehyde unites with an active hydrogen atom from a foreign molecule to form the methylol group. In this manner it is possible to produce a primary alcohol. If the foreign molecule contains two or more active hydrogen atoms, it is possible to produce polyhydric alcohols, all of the alcohol groups being primary. The primary alcohol may dehydrate to form an unsaturated compound. A similar reaction involves the union of formaldehyde with single active hydrogens from each of two foreign molecules to form a methylene bridge. By the several variations of this single fundamental reaction it is possible to produce either a primary alcohol, an

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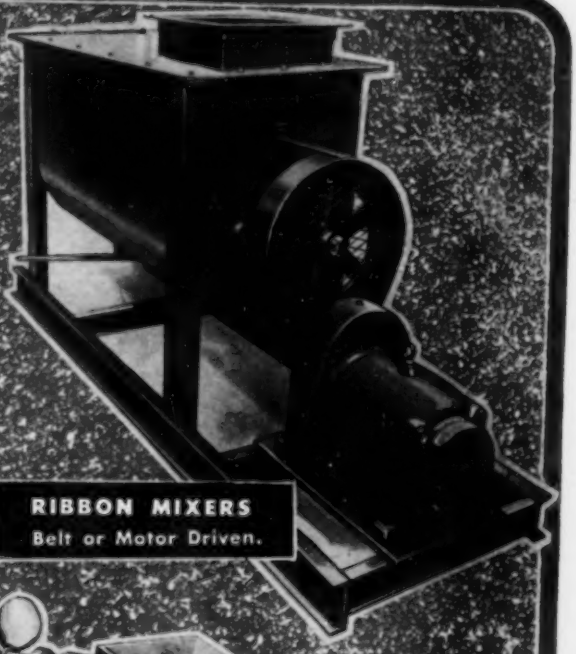

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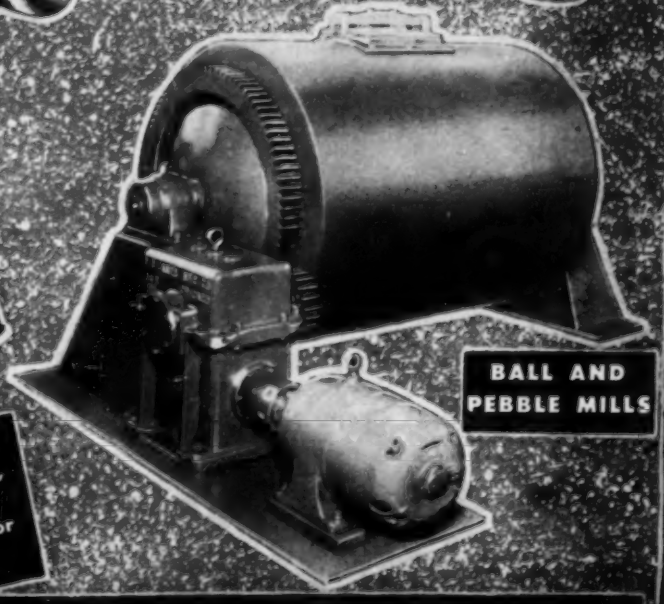

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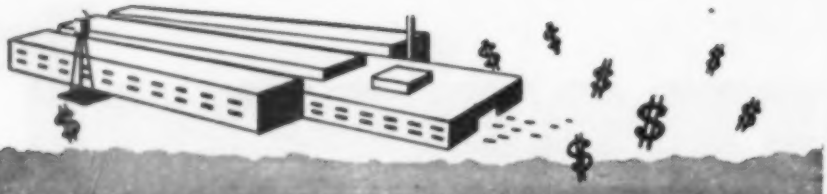

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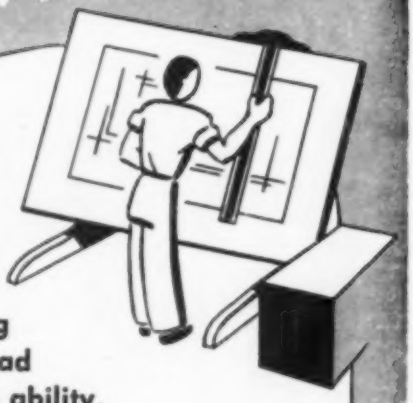

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unsaturated compound or a methylene-bridged product, all these being potentially important as intermediates in the synthetic surface coatings field.

On passing paraffin hydrocarbons containing at least six carbon atoms in a straight chain over a suitable catalyst at an elevated temperature a large proportion of the paraffins are converted to aromatic hydrocarbons. When octane is used as charge, ethyl benzene and the three isomeric xylenes form. Accordingly, through this process (aromatization), a paraffinic petroleum naphtha may be largely converted into a mixture of aromatic compounds. It is possible to separate o-xylene from this mixture by careful fractionation. By partial oxidation, this aromatic is converted into phthalic anhydride. This procedure for the preparation of phthalic anhydride, which is being employed on the commercial scale, relieves in some measure the acute shortage of naphthalene, the usual charging stock for phthalic anhydride production.

Benzene may also be produced by the catalytic aromatization of petroleum naphthas although the formation of the parent compound is more difficult than the preparation of its alkyl derivatives. Benzene may be converted to the anhydride of another dicarboxylic acid, maleic acid, by catalytic partial oxidation. This acid is extremely useful to the surface coatings industry and may, in addition, be easily converted into interesting derivatives. For example, maleic anhydride reacts readily with butadiene to form tetrahydro phthalic anhydride. This acid is of great interest in its own right and furthermore is easily converted (by hydrogenation) into hexahydro phthalic anhydride, a compound which can also be made by the complete hydrogenation of the homocyclic ring of phthalic anhydride itself. Accordingly, it is easily possible to form dicarboxylic acids.

Polyhydric alcohols (for example, pentaerithritol) can be made starting with gaseous petroleum hydrocarbons as raw materials. By the esterification of polycarboxylic acid with a polyhydric alcohol high molecular weight compounds (alkyd resins) can be formed. In some cases it is advantageous to use materials such as trimethylol ethane or trimethylol propane, which contain but three primary alcohol groups, in place of pentaerithritol which contains four. These polycarboxylic acid-primary polyhydric alcohol resins exhibit excellent film-forming characteristics, being in general superior to similar resins made with glycerine.

Robert F. Ruthruff, Sherwin-Williams Co., before Midwest Regional Meeting, American Chemical Society, Kansas City, June 1947.

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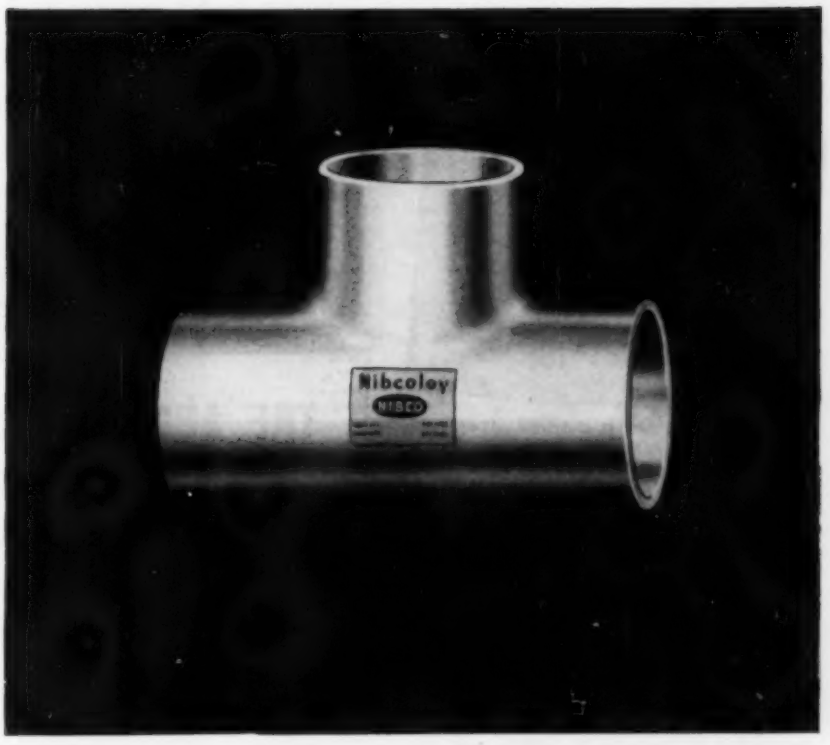

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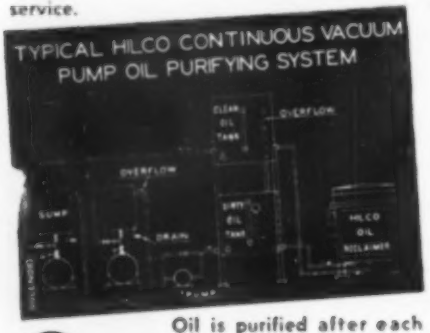

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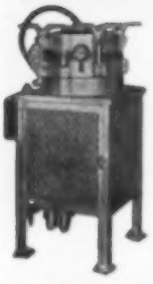

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FOREIGN LITERATURE ABSTRACTS

Methane Adsorption With Charcoal

IN SYNTHETIC ammonia manufacture, part of the nitrogen-hydrogen mixture is withdrawn from the cycle to remove accumulated methane, which is produced by the reaction of the impurity CO present in the nitrogen-hydrogen mixture, with hydrogen. Since this involves a loss of up to 3.8 percent of the nitrogen-hydrogen mixture, another more effective method for removal of methane was sought. Work was therefore conducted on adsorption of methane from the nitrogen-hydrogen mixture by means of activated charcoal. Activated charcoal of the BAV-20 brand was found to remove methane from a nitrogen-hydrogen mixture completely at first. The time of protective action at a rate of gas current of 15.9 ml. per min. per sq. cm., temperature of sorption of 16 deg., CH_4 concentration in the gas mixture of 3.3 percent, is expressed by the equation $\theta = 4.4L - 0.8$, in which θ is the time of productive action in minutes and L is the size of the layer of activated carbon in centimeters. Increase in temperature of sorption is accompanied by a decrease in the time of productive action and it changes within the investigated range, according to the equation $\theta = 15.5 - 0.1t$, in which t is the temperature of sorption in deg. C. Increase in pressure has a favorable effect on the increase in time of productive action and on the volume or quantity of methane adsorbed.

Digest from "Adorption of Methane with Charcoal" by I. P. Kirillov and E. S. Rakhlin, *Zhurnal Prikladnoi Khimii* XIX, No. 5-6, 511-516, 1946. (Published in Russia.)

Thermal Decomposition Of Kaolin

EXPERIMENTS were carried out on three clays of known composition, two kaolins from Zettlitz and a pholerite (pure kaolin) from Neurode which were heated in an electric furnace in different atmospheres: air, CO and CO_2 in order to study the action of these gases on the process of dehydration of kaolin and of the solubility in HCl of the alumina formed during the treatment. The meta-kaolins obtained by heating between 400 and 800 deg. C. depend strictly on the nature of the furnace gas insofar as dehydration and activity of the alumina formed are

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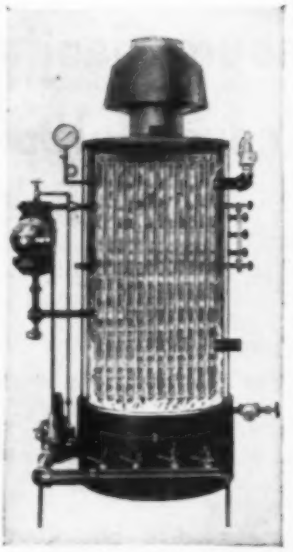

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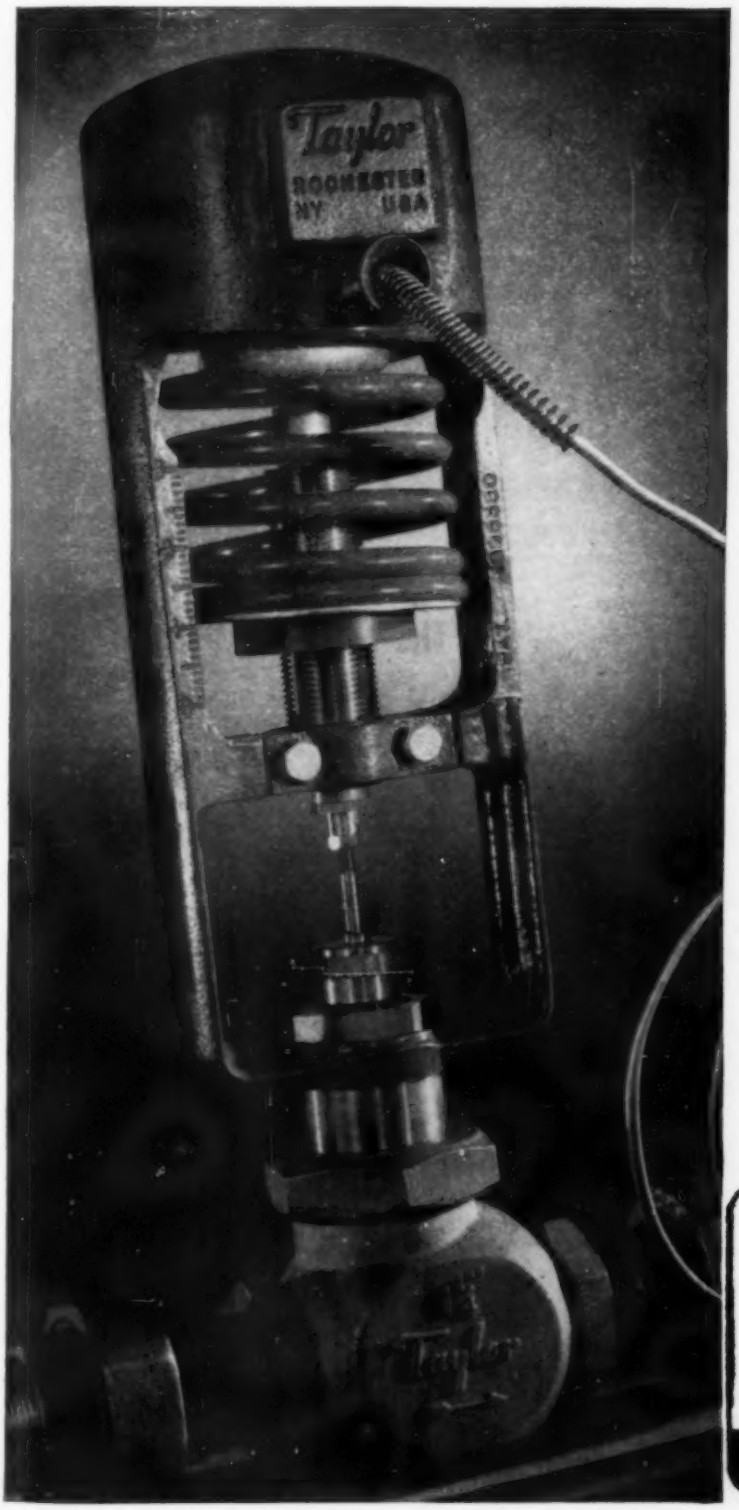

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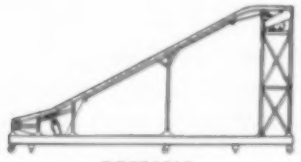

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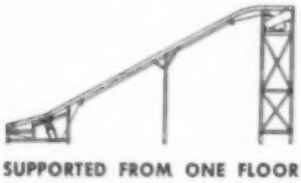

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concerned. In general, carbon dioxide gas, as compared to carbon monoxide, promotes loss of water and solubility of the alumina. Carbon monoxide has the same relationship to air, but the differences are slighter. The same phenomena occur with pure alumina. According to the results obtained relative to the activity of the gases which are inactive in the usual chemical sense of the term, the effects observed are also related to the action of the gases on the process of recrystallization and to the surface dimension of the powder rather than to a higher reactivity resulting from solution of the gas in the mass. These effects play a more important role in reaction with powders where the influence of the gaseous phase is greater, a phenomenon which should attract more attention in practice than in the past. When carbon monoxide is used, disturbances appear which are due to the reaction $2CO = C + CO_2$. An electric furnace with strictly constant temperature is necessary in order to make a comparison of the different tests. In the case of the three kaolins, the solubility of the alumina passes through a maximum after heating up to 465 deg. C. For pholerite this critical temperature attains 500 deg. C.

Digest from "Influence Exercised by the Atmosphere of the Furnace on the Thermal Decomposition of Kaolin and on the Reactivity of Al_2O_3," *Ark. Kemi*, Stockholm, 19, No. 4, 1-14, 1945; *Chimie et Industrie* 55, No. 2, 123, 1946. (Published in France.)

Penicillin Plant For Italy

EQUIPMENT required for the manufacture of penicillin has already arrived in Italy and will be installed in a plant which is to be located in Rome. The penicillin will be produced in the usual manner by cultivation of the mold *Penicillium notatum* and collection of the excretions. Like all other plants, this mold requires food and is therefore provided with a liquid nourishment in the form of a dark brown liquid containing sugar, mineral salts and other substances. From 23,000 to 36,000 hectoliters of this liquid food are required to produce less than 45 kg. of dry penicillin. The mold is cultivated on the surface of the liquid and after incubation the mold is removed and the penicillin extracted.

Digest from "Penicillin Plant under Construction in Rome," *Tecnica Italiana* II, No. 1, 43, 1947. (Published in Italy.)

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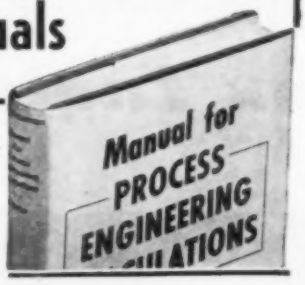

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The Chemical Process Industries

By R. NORRIS SHREVE, Professor of Chemical Engineering, Purdue University. 957 pages, 256 illustrations, $8.00. Makes available in handy reference form a compilation of data on modern methods used in the manufacturing of chemicals and chemical products. Manufacturing procedures for all chemical process industries are analyzed and described by flow sheets, showing the interrelationship of the basic unit processes and operations.

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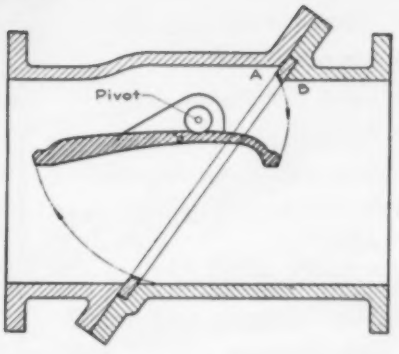

Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

There's only *one moving part* in Chapman Tilting Disc Check Valves—the balanced hinge-pinned disc. When opened, the disc rides smoothly in the flow, minimizing wear on bearings and hinge pins. And since the disc seat lifts away when opening, and drops back when closing, there's minimum wearing of the seats. The disc closes quickly and quietly because of the effect of the stream against the short flap. Hammering and consequent strains on pipe lines are eliminated.

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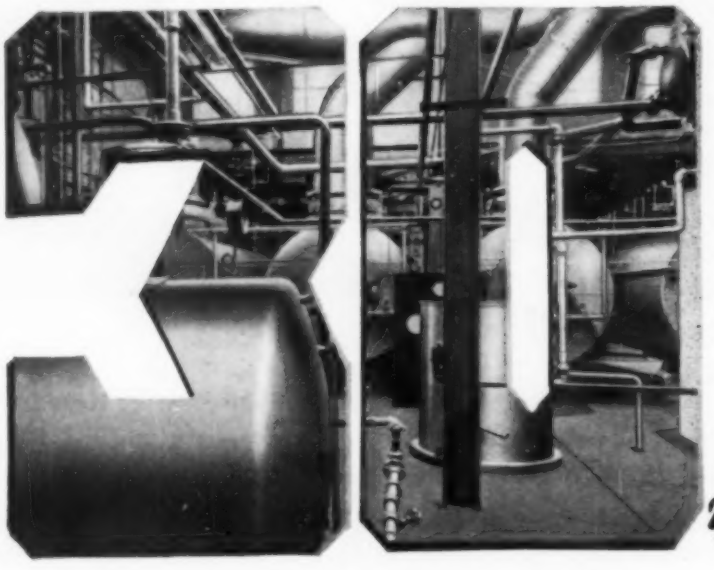
basis of many years experience under actual chemical plant conditions. The attached table gives the advantages and disadvantages of each system to help in the selection of the one most suited for specific industrial applications.

Digest from "Remote Control with Valves and Gate Valves in the Chemical Industry" by V. E. Moroshkin, *Khimicheskaya Promyshlennost* No. 6, 159-166, 1947. (Published in Russia.)

Advantages and Disadvantages of Remote Control Systems

	Pneumatic Systems	Hydraulic Systems	Electric Systems	Combined Systems
Safety in regard to fire and explosions	Perfect	Safe	In an explosive atmosphere all installations have to be of a suitable type, which complicates the unit	Safe when there is suitable arrangement of electric relay, points of control, and type of electric system
Resistance to corrosion	Good	Good	In a corrosive atmosphere it is necessary to carefully seal the housings, glands and specially laid lines. Important parts: contacts, springs, windings, etc. require special materials and alloys	Have good resistance if properly planned
Range of action	Limited to a distance up to 75 m. when intensifying devices are not used	Limited to a distance up to 40–50 m.	Practically unlimited	
Acting mechanisms	Simple and easy to maintain	More simple and easy to maintain	Usually more complicated than the preceding ones. Often require special precautions against explosions as well as protection from corrosion	Simple and easy to maintain. Require additional attention to intermediate relays
Ease of servicing	Depends on training and knowledge of the system of control			
Initial expenditures	Depends on types of apparatus. If no ready air or gas is available, may be higher due to cost of compressor unit	Depends on types of apparatus	Depends on type of unit. Can be less than pneumatic or hydraulic if the distance is not great and no precautions have to be taken against explosions	Depends on type of unit. Can be more expensive than all systems if there is no ready air or gas, as well as an oil-pressure unit
Cost of operation	Energy for operation costs more	Energy costs less than pneumatic system but more than in electric	Energy costs less but the advantages cancelled by higher initial expenditures	Energy costs higher than all other systems
Energy requirement	Constant supply of pure and dry air or non-corroding gas	Constant supply of hydraulic liquid	Constant supply of electric power of stable voltage	Constant supply of two types of power of constant parameter
Negative properties	Control apparatus gets dirty and corrodes when purification and drying of air is not complete. Condensate may freeze in lines	Leaks in the joints of oil conduits with unskilled assembly	Electric contacts burn when assembly is unskilled. Electric systems are subjected to various injuries if not properly planned and assembled	Same as for the preceding ones



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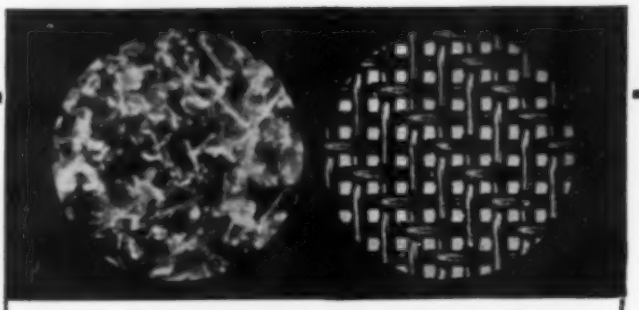

These two photomicrographs show that a Celite filter cake has smaller openings than the finest filter cloth. It's the filter cake—not the cloth—that removes the suspended impurities.

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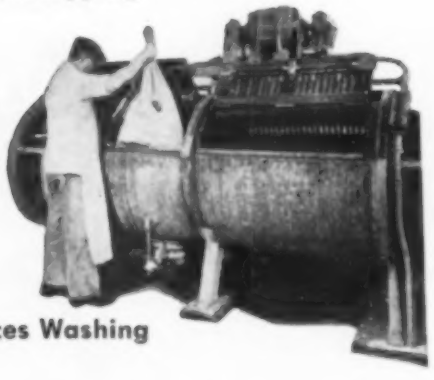

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Lester B. Pope, ASSISTANT EDITOR

Recommended

CHEMICAL ENGINEERING FUNDAMENTALS. *By Chalmer G. Kirkbride. McGraw-Hill Book Co., New York. 417 pages. $5.*

Reviewed by C. M. A. Stine

C. G. Kirkbride

IN HIS book "Chemical Engineering Fundamentals," Dr. Kirkbride has prepared for the students in chemical engineering a valuable discussion of the many and varied considerations involved in both teaching and practice of chemical engineering. He has seen fit to digress from the somewhat stereotyped approach to chemical engineering by the route of the unit process, in an effort to give the young student an early introduction in his curriculum to the basic philosophy underlying chemical engineering. While some of the chapters of this interesting book may be pretty stiff going for the student in his sophomore year, it is safe to say that a mastery of the contents of the book will go far toward qualifying him for either his first experience as a teacher, or as a practitioner of chemical engineering.

Dr. Kirkbride states in his preface, "In the past, many students have been graduated with the erroneous belief that the unit operations are themselves the fundamentals of chemical engineering, rather than mere applications of the fundamental principles." To correct this impression, he has addressed himself in the pages of this book to imparting to the student a "thorough philosophical insight into the fundamentals of chemical engineering." It seems to me that the value of the book lies in its ability to give to the young student a proper appreciation of the true fundamentals upon which all chemical engineering applications must rest.

In reviewing the book, the writer has few criticisms indeed. It is certainly true that the chemical engineer must be able to cooperate with associates a quite varied background and training, and must be able to work harmoniously as an integral part of the modern research "team" which so frequently has proved to be the best approach to the solution of problems in chemical manufacture. It has seemed to me that a market appraisal of potential competition might be somewhat more emphasized in connection with the work of the chemical engineer. It also appears to the writer that the sentence, "Rarely does commercial performance equal that obtained on small laboratory equipment," is perhaps a little too strong a statement. His experience has been to the contrary, in that frequently, continuous processes working at elevated pressures with catalyst beds narrowly controlled as to temperature have actually given better results on the operating scale than those encountered in the preliminary laboratory work.

Pilot Plant Value

It has also been the writer's experience that a pilot plant, where it is feasible to construct one, is of very great value indeed in appraising "the probable economic optimum range of process variables for commercial operation." In varied chemical manufacturing operations pilot plants have proved indispensable adjuncts to the successful reduction to practice of multi-step chemical manufacturing operations. In connection with the use of pilot plants for actual commercial manufacture, it should be said that over-expenditures for initial pilot plant construction are fostered by attempting to combine such a commercial development with the study of the proposed operations to enable the proper selection of process equipment for ultimate plant design. This is especially true because the initial pilot plant frequently undergoes many alterations in the course of the development of the process. Any decision to dispense with a pilot plant and attempt to translate laboratory results directly into a manufacturing plant scale should be arrived at, as a rule, only when the process under consideration involves no major uncertainties as to equipment or conditions of operation.

In connection with this discussion of pilot plants, Dr. Kirkbride states "As the pilot plant investigation proceeds, process appraisals should be made." Such appraisals "show where important improvements would be desirable from an economic standpoint . . . Improvements that have little economic significance hardly justify the cost of investigation." The writer desires to add to Dr. Kirkbride's statement the qualifying clause that improvements which insure safer operating conditions are always highly desirable. If the writer has any quarrel at all with Dr. Kirkbride's book, it is with the lack of emphasis upon safe operations in all types of chemical engineering plant operations. Safety has come to be recognized as one of the most important of all considerations in plant design, in order that ultimate manufacturing operations may be as free as possible from physical hazards.

Dr. Kirkbride states that the chemical engineer "will learn the limits to which he can trust his calculations based on theory, and the size of safety factors he should use to compensate for the inaccuracies." I should also like to add that it is exceedingly important that the young engineer learn to appraise the human factors in his calculations, for even the most experienced and conscientious operators are fallible.

It seems to me that the young engineer should be thoroughly indoctrin-

RECENT BOOKS RECEIVED

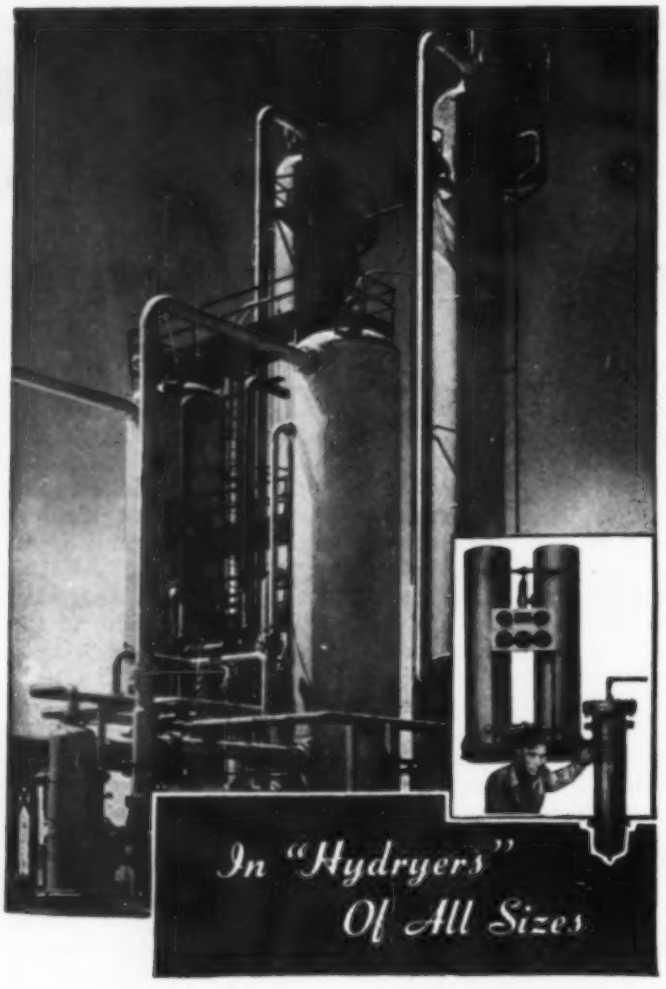
The Chemistry and Technology of Waxes. By A. H. Warth. Reinhold. $10.

Encyclopedia of Chemical Technology, Vol. I. By R. Kirk & D. Othmer, Interscience. $20.

High Vacua. By S. Jnanananda. Reinhold. $5.50.

Industrial Health Engineering. By A. D. Brandt. Wiley. $6.

Powder Metallurgy. By P. Schwarzkopf. Macmillan. $8.



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ated in the idea that experimentation on a manufacturing scale is expensive, unsatisfactory, and should by all means be avoided. This again points to the great value of a pilot plant.

In Chapter 9, is the statement that the chemical engineer will find in his practice that maximum profit per unit time is the guide which he must always follow. Maximum profit per unit time can only be attained with safe operations, and this should be emphasized. The personal safety of the operators is a prime consideration in all commercial manufacturing operations.

Another factor which might be somewhat more emphasized is the problem involved in waste disposal. Water and air pollution with industrial wastes dare never be ignored. There are many angles to the considerations of waste disposal, and some of them might profitably be brought out for the young student in chemical engineering.

Reports

In Chapter 10, which deals with the presentation of technical results, the writing of clear, concise, and convincing technical reports is discussed. This has long been a subject of discussion among those responsible for the organization and conduct of chemical engineering research. Numerous papers have been written dealing with the considerations involved in the preparation of such a report. Dr. Kirkbride has, quite properly, given a good deal of space to the presentation of the subject.

His "theme sentence" is intended to introduce the report by presenting to its reader the subject and purpose of the report. Dr. Kirkbride's example, "The data on catalyst life show conclusively . . ." actually does more—it presents at the very beginning of a report, in brief summary form, the conclusions arrived at as a result of the work reported, and this is precisely what it should do. Subject, purpose, and conclusions should always be briefly summarized in the introductory paragraphs of a good technical report. Here, too, is the logical place to state, as succinctly as possible, the recommendations which are later developed in detailed form and logically connected with their supporting data.

In general, it appears to the writer that the 19 pages which Dr. Kirkbride devotes to the subject of the presentation of technical results should be "must reading" for the student of chemical engineering.

In general, the writer has no hesitancy in strongly recommending Dr. Kirkbride's book as affording an ex-

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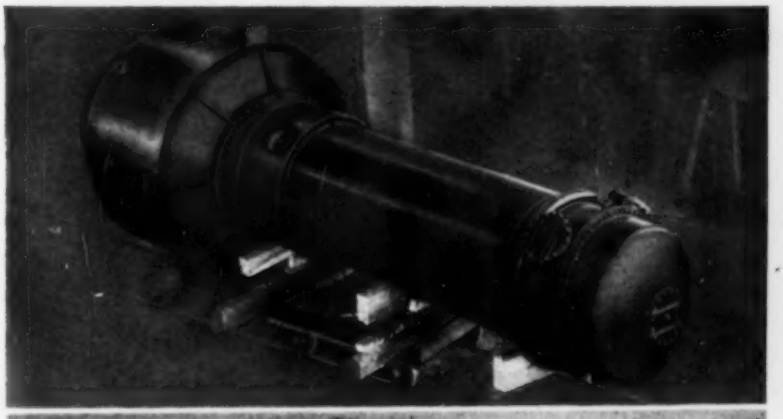

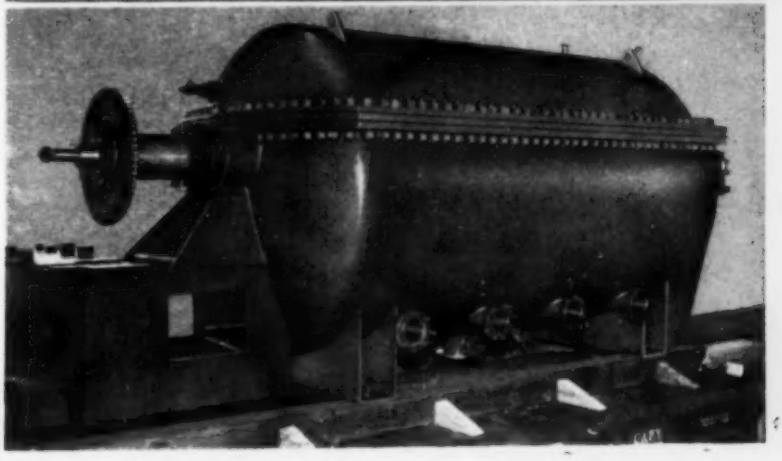

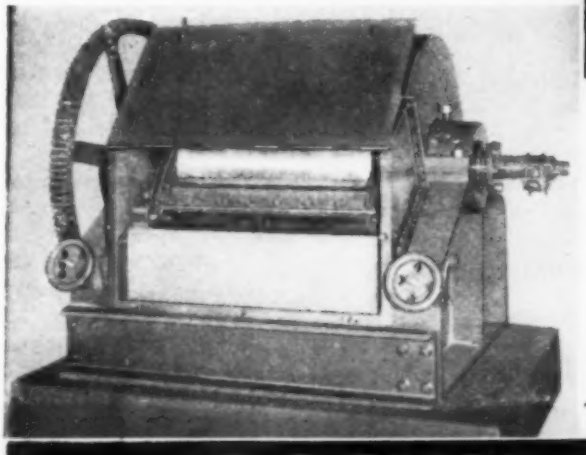

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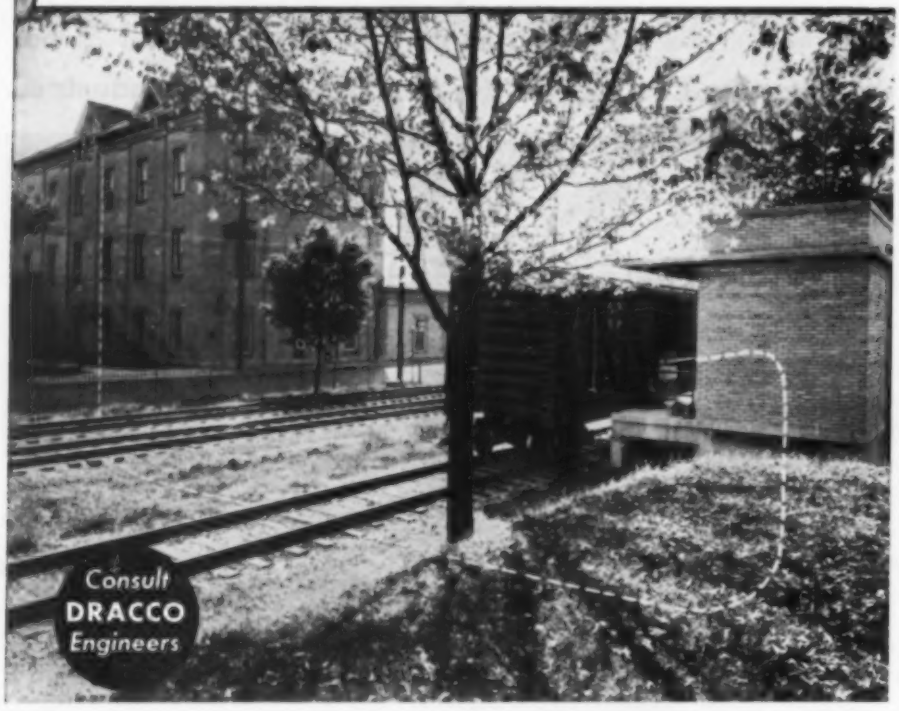

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cellent text for the chemical engineering student. Its discussions and examples have been well chosen for the purpose for which they are designed.

Cereus Romance

ADVENTURES IN MAN'S FIRST PLASTIC. *By Nelson S. Knaggs. Reinhold Publishing Corp., New York. 329 pages. $6.75.*

Reviewed by H. C. Parmelee

IN A POPULAR quiz game you are asked to identify substances by answering the question "Animal, vegetable, or mineral?" If the indicated substance was just "wax" you could answer correctly "All three." But you might be puzzled if the quizzer named specifically "spermaceti," or "esparto," or "ozokerite." For the source of waxes is so varied in origin and so widespread in geography that all three natural kingdoms contribute to this amazing group of substances. Sperm whales and insects, palms and grasses, liquid and solid minerals yield waxy materials that find commercial use in numerous arts and industries.

The author has titled his book well, for there is unsuspected high adventure and romance in the commerce and trade in waxes; and the contents of the book live up to the promise of the title. Indeed, the author combines to an exceptional degree the technical knowledge of his subject with ability to write about it in entertaining fashion. And, considering the world-wide nature of the industry, he treats much of it with personal, first-hand information. Typical is the opening chapter describing his expedition into the jungles of the Amazon in search of new wax-yielding botanicals. Quite different, but nonetheless fascinating, is the chapter dealing with the age-old uses of wax, man's first plastic. Here the author delves into archaeology, and traces the use of wax in religion, art, Egyptian mummy making, candles, the invention of lithography, Madame Tussaud's wax models of famous persons, and Edison's talking wax cylinder. As a byproduct of exploring the Big Bend area of Texas in search of candelilla, the reader is introduced to the legendary and fabulous Lost Nigger gold mine. In the chapter on beeswax the author offers a liberal education on the honey bee and its traditional industry. And if the story of Chinese insect wax is not a personal experience, it is nevertheless highly dramatic in its portrayal of Chin-Lu and the Wax Caravan transporting the precious eggs of *Coccus Pela* nearly 200 miles over hazardous mountain routes from the valley of Chiench'ang to Loshan in the

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province of Szechwan, where the eggs are placed on host trees to hatch and produce wax. Altogether, the book offers entertainment as well as in instruction in exploration, botany, entomology, archaeology, and chemistry, to which the author's photographs add further interest.

Underlying Principles

CATALYTIC CHEMISTRY. *By H. W. Lohse. Chemical Publishing Co., Brooklyn. 471 pages. $8.50.*

Reviewed by F. C. Nachod

DR. LOHSE's text is "aimed at a brief, factual presentation of the underlying principles of catalytic phenomena and the application of catalytic reactions in industrial processing." This has been achieved remarkably well, and while the book is not on the same level of comprehensiveness as the standard reference works such as Schab's treatise, it appears to be extremely useful as both work manual and primary reference. The chapters cover a historical introduction, catalytic theory, nature and properties of catalysts, types of catalytic reactions, and industrial catalysts. The author stresses the concept of purity and the role of traces of substances which may act catalytically.

A considerable amount of literature reference is given and typographical errors are few. Dr. Lohse's text deserves recommendation as a work manual and survey of catalysis.

From USSR

KONTROL' KOKSOKHIMICHESKOGO PROIZVODSTVA. *(Methods of Control in the Coking Industry.) Third corrected and supplemented edition. By L. D. Gluzman and I. I. Edel'man. Metallurgizdat, Moscow. 455 pages.*

Reviewed by J. G. Tolpin

ANYONE who believes that a grain of useful technical information may pay for reading a considerable amount of generally known facts would want to keep in his library not only the current Russian periodical literature relating to his field, but also books, since Russian technical books occasionally report data insufficiently known through other sources. It is also interesting to get a view of the new methods, especially those developed in the USSR, which have reached commercial utilization there.

The book under review belongs in this category. It was written by the authors for chemists working in coking plants in the USSR, and its chapters on analysis and control refer to several methods originally developed

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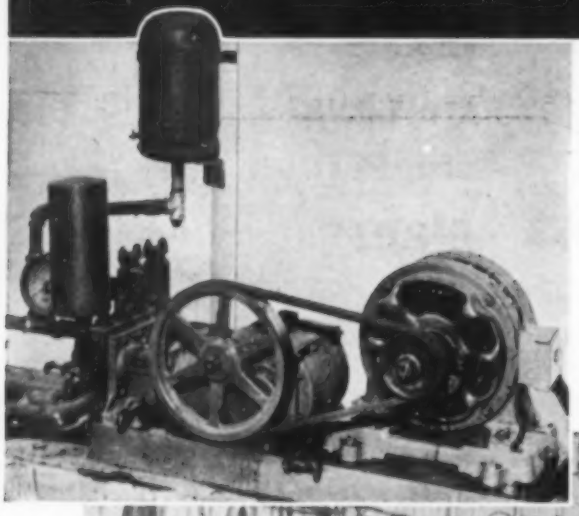

View at left shows one of the Deming "Oil-Right" Single-Acting Horizontal Pumps used for multiple testing of range boilers in the plant of a nationally known boiler manufacturer. Partial view of one of the testing departments is shown below.

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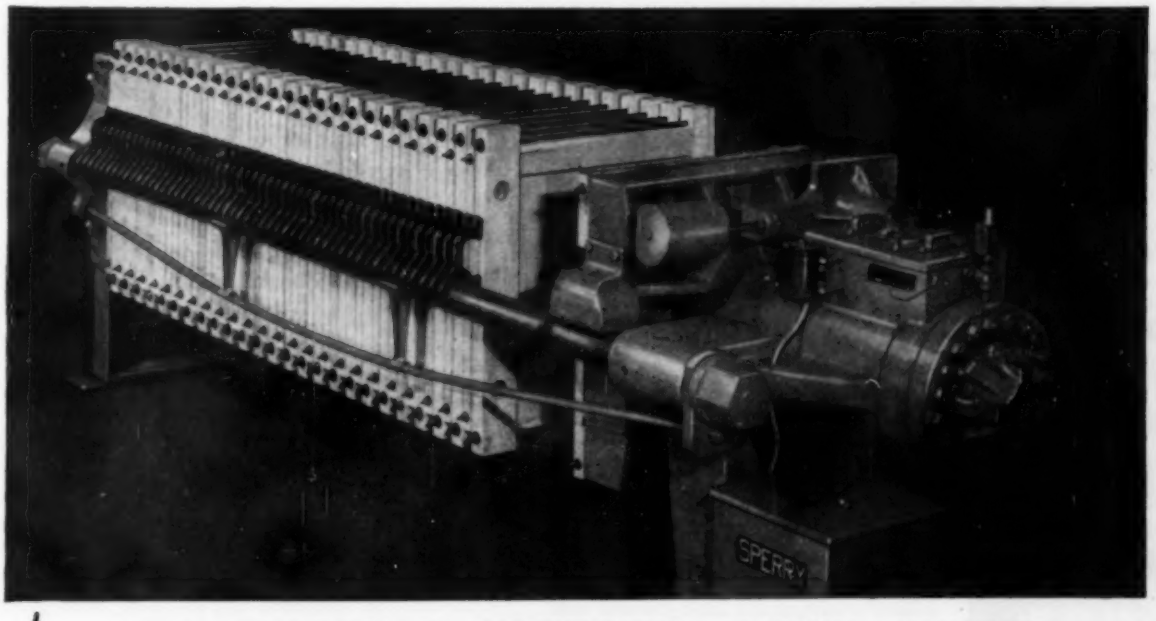

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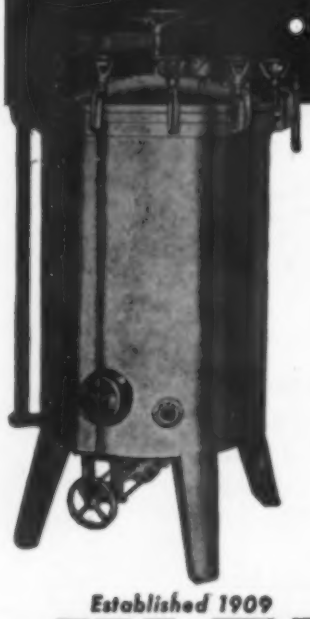

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in the USSR, as well as foreign methods, a number of them German, adapted or modified by the Russians. The first part of the book concerns itself with control of coal concentration, assaying of coal and methods of control of the coking process; the second part is devoted to separation and processing of gas and tar components. Control of manufacture and isolation of some relatively new coal-tar products, such as pure pyridine, is not treated here; these subjects are treated in a forthcoming publication of the authors.

The subject matter is clearly presented without any irrelevant discussion.

Unexact Science

SOILLESS GROWTH OF PLANTS. *Second Edition. By Carleton Ellis and M. W. Swaney; revised by Tom Eastwood. Reinhold Publishing Corp., New York. 277 pages. $4.75.*

Reviewed by John R. Callaham

IN 1938, when the first edition of this book appeared, the science and industry of soilless plant culture (hydroponics, chemiculture, water, sand or gravel culture) was hardly more than an experimental novelty. During the war, hydroponics was used on a number of Pacific islands by the U. S. Army Air Force to provide fresh vegetables to isolated garrisons. Today, this technique of growing plants successfully in spite of adverse soil, climate and soil organism conditions is used in large-scale installations in the United States, especially in Florida, by the U. S. Army on Ascension Island and Iwo Jima, and by subsidiaries of Shell Oil Co. and Standard Oil of New Jersey in the Netherland West Indies. Developments are under way in Japan.

Hydroponics is now recognized as a highly specialized branch of agriculture and horticulture. As a commercial venture, its success is governed by delicate economic conditions that are different for each locality, plant or crop, and installation. As a hobby, it is fascinating for those who like to play and putter with plants or grow prize onions. As such, this reviewer recommends it (with reservations) as a peaceful and soothing pursuit for those botanically-minded chemists and engineers with limited gardening space. It is a tonic for the weary and workbound.

This book on soilless plant growth (one of the best and most practical available) should appeal both to the commercial and amateur chemiculturist. It is well illustrated with photographic reproductions and schematic

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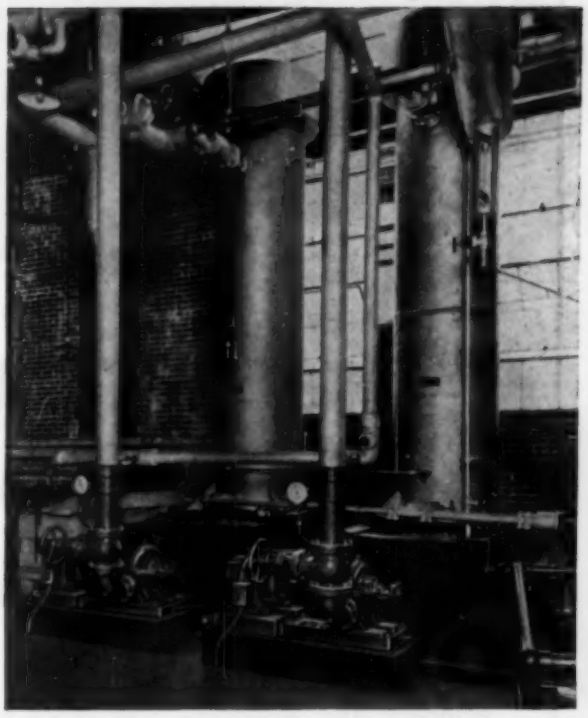
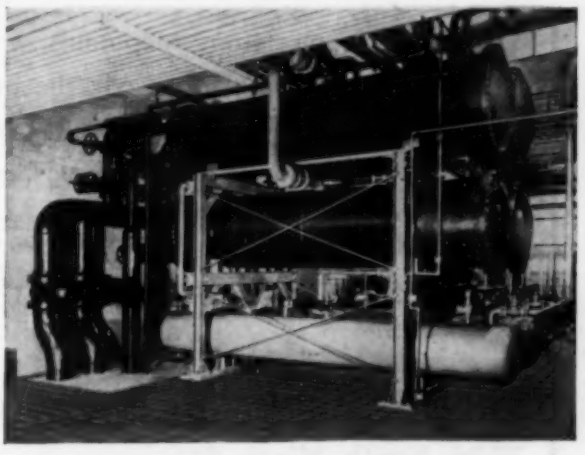


Worthington Vertical "Spira-Flo" Condensers installed inside building. Worthington Pumps in foreground.



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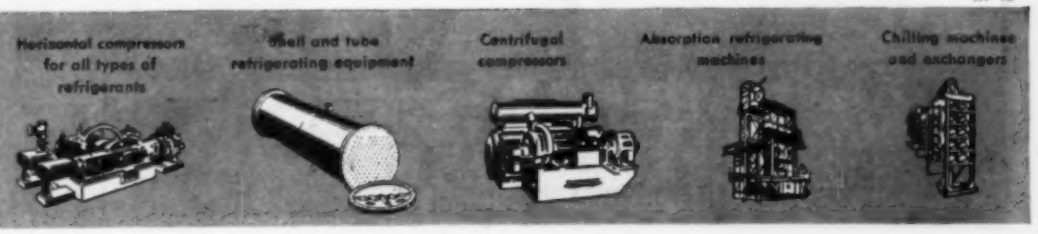
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Shell and tube refrigerating equipment
Centrifugal compressors
Absorption refrigerating machines
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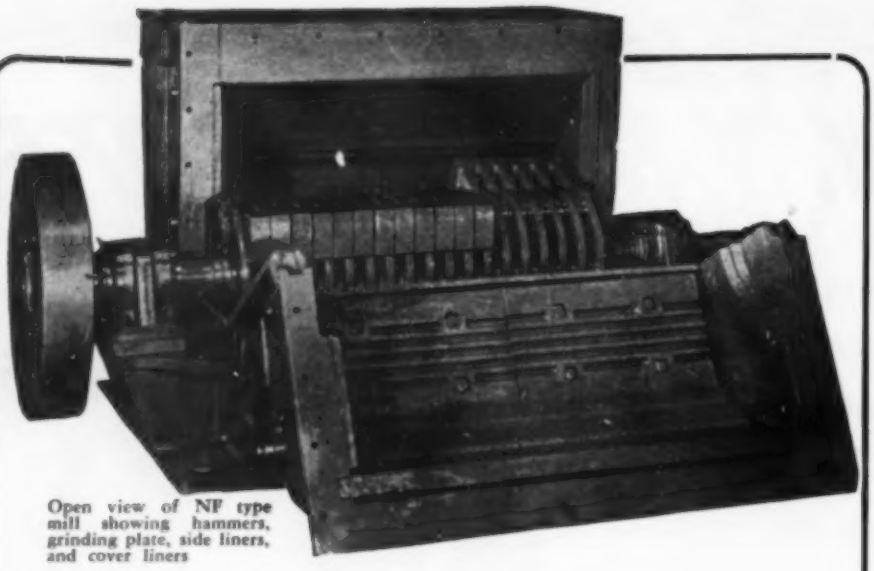

Open view of NF type mill showing hammers, grinding plate, side liners, and cover liners

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drawings. The super-scientific experimenter can draw upon the bibliography for more detailed directions. It is well to remember, however, that soilless plant culture is not quite yet an exact science—but therein lies the fun of guessing and gambling.

For Electroplaters

HANDBOOK OF INDUSTRIAL ELECTROPLATING. *By E. A. Ollard and E. B. Smith. Published by Metal Industry (London).* 308 *pages.* 15s.

Reviewed by Louis Weisberg

THIS BOOK is directed to those having to do with the design, installation, operation or maintenance of plants for electroplating. It is strictly a practical book, clearly written, easy to read, and filled with facts and figures about methods and equipment currently used in the British electroplating industry. Only by excluding all discussion of theory and principles could the authors have packed so many facts into such a small book.

Unfortunately for American platers, a considerable part of the material presented is so closely tied in with British practice and equipment that it is not directly applicable to conditions in this country. For instance, several types of pumps made and used in England are described in detail, but centrifugal pumps are not even mentioned. The use of silicon-iron alloy for making pumps and heat exchangers is not mentioned either. In American plating practice, centrifugal pumps and heat exchangers made of silicon-iron alloy are widely used. A similar situation arises with respect to certain other equipment, such as rectifiers and magnetic thickness testers.

Except for this drawback, this is a handy book for reference and assembles in convenient form a wide variety of information useful to the practical electroplater.

Industrial Emulsions

PRACTICAL EMULSIONS. *By H. Bennett. Chemical Publishing Co., Brooklyn.* 568 *pages.* $8.50.

Reviewed by A. H. Pope

SECOND edition of "Practical Emulsions" is a rather thorough revision of the first. Starting with the table of contents, which has been appreciably expanded, the author has worked over virtually all parts of the book.

The first section of the book deals with discussions of emulsions and their properties, emulsifying agents, and includes listings of various types of surface active agents. The text of this section follows the first edition in a general way but there has been some

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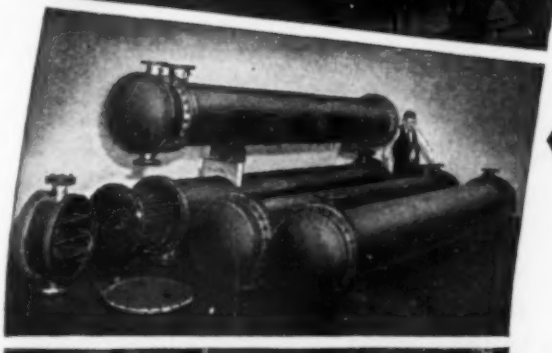

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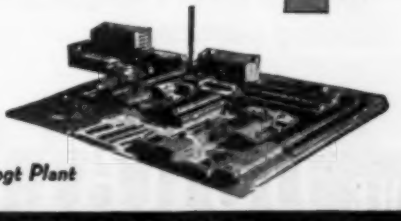

Air View of Vogt Plant

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change of emphasis. True to the theme of the book this section is a good discussion on the practical aspects of industrial emulsions. The listings of surface active agents do not appear to have been expanded at all. This is especially disappointing to one trying to keep up on the more important additions to the field of dispersing and wetting agents.

Entirely new to the book, the second section is a symposium of papers on emulsifying agents and emulsions. Emulsifying agents discussed include lecithin, pectin, soap, and polyhydric alcohol compounds, with a paper on surface active agents as germicides thrown in. The second chapter in this section is a series of discussions on emulsions in seven different industries.

It is in the third section that Mr. Bennett lets loose with the material near and dear to his heart—formulas. These deal with 20 different types of emulsion applications. The layout of this section has been improved and a few new formulas have been included.

The book is well referenced but most of the formulas are, of course, taken from Bennett's "Formulary."

The text touches only lightly on theoretical aspects but should be of interest to those concerned with making and applying industrial emulsions.

Technological Study

COATING AND INK RESINS. *By William Krumbhaar. Reinhold Publishing Corp., New York. 323 pages. $7.*

Reviewed by C. F. Silleck

SUBJECT matter of Dr. Krumbhaar's text is considerably narrower than the title implies. Discussion is actually limited to pure and rosin-modified phenolic, rosin-modified maleic and "copal-type" synthetic resins. Following the establishment of certain chemical and physico-chemical fundamentals and concepts, each type is discussed in detail. Unfortunately the brief statement of the functionality idea on p. 27 is not entirely correct. The author states that dibasic acids or dihydric alcohols, when reacted together, are incapable of giving rise to resinous substances, and that ". . . in order to form resins, it is necessary that one of the reacting alcohols or acids is at least dibasic and the other one is at least tribasic, . . ." Direactive alcohols and direactive acids react together to form resins of the convertible type. Dr. Krumbhaar's earlier volume, "The Chemistry of Synthetic Surface Coatings," contains a more accurate review of the functionality concept.

While certain of the author's views

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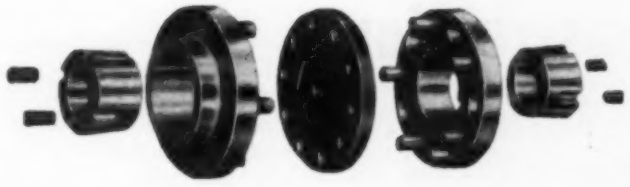

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may not find full accord with those of other workers in the field, his presentation is of exceptional interest and is very stimulating. Of particular interest may be mentioned the general information on molecular weights; the discussion on the reactivity of phenolic and alcoholic hydroxyl groups for acid and alkali catalyzed phenolic resins in general and with rosin in particular; his views regarding the rosin-maleic reaction; the explanation of loss of drying in maleic resin varnishes as attributable to the formation of insoluble cobalt and lead succinates, the succinic acid resulting from the reducing action, at high temperature, of organic matter on the maleic radical.

Chemical characteristics of resins are treated against the background supplied by previous discussions of the individual types. Acid number, saponification value, chemical analysis, molecular weight determination, acetyl values, methods of evaluating resin reactivity are discussed and procedures in the author's laboratory are presented. It would seem desirable if the author's many valuable, and often unique, methods were set apart from the reading text by distinctive type and headings. Such a device would render the book of greater use to the laboratory worker, permitting him to locate the procedures more readily. It is regrettable that very frequently the use of 10N alcoholic KOH is specified, as on p. 153, when obviously 0.10 N is the normality intended.

Physical characteristics of the resins under consideration and their practical performance are treated from the standpoint of their influence; first, upon surface coatings, and second, upon printing inks. A full understanding of the remarks on these phases of the subject, augmented by the discourse on the application of resins in the coating and ink field, will be of definite assistance to the coating and ink formulator.

Special equipment utilized in the synthetic resin industry is adequately covered, being based on the author's wide experience with resin units of various types. Particular emphasis is placed on electrical heating methods as used in Dr. Krumbhaar's own modern resin plant.

The chapter on the patent situation might well be read by chemical workers in all fields of science. Naturally it is directed at the resin, coating and ink fields, but the general tenor of the discourse would be valuable to technical executives in any sphere of research.

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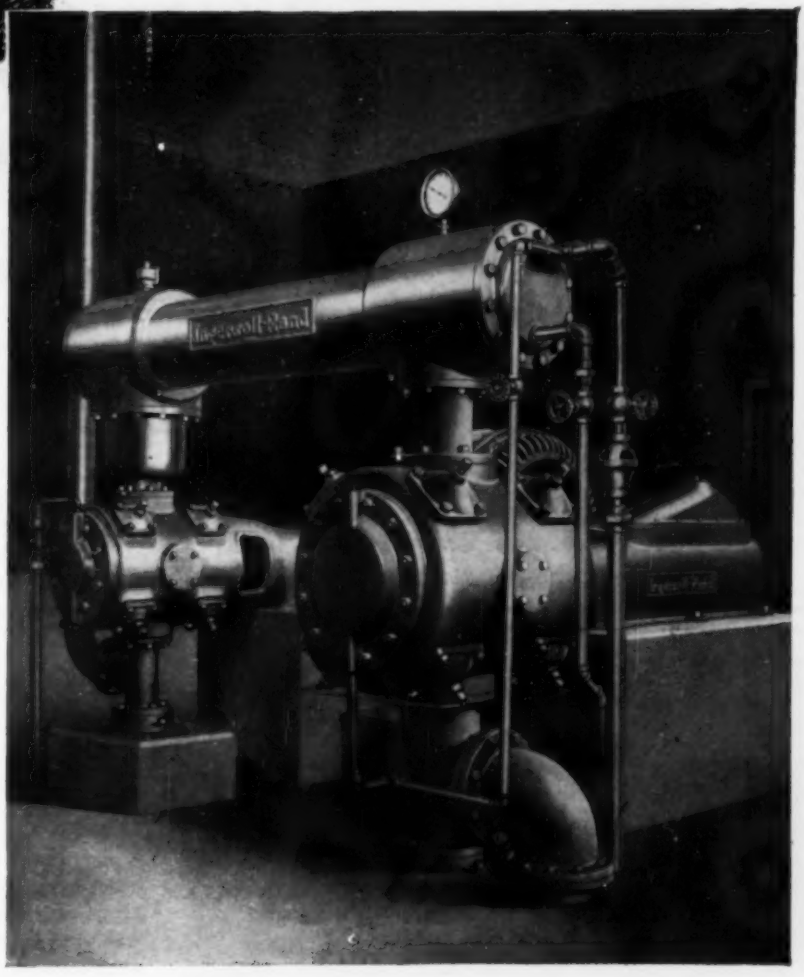

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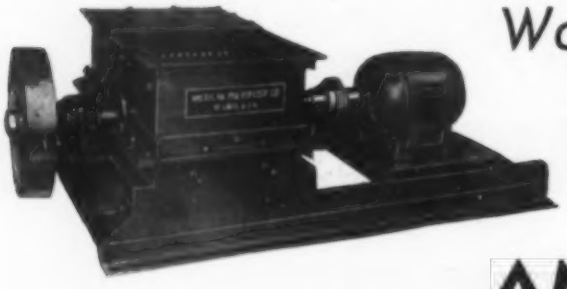

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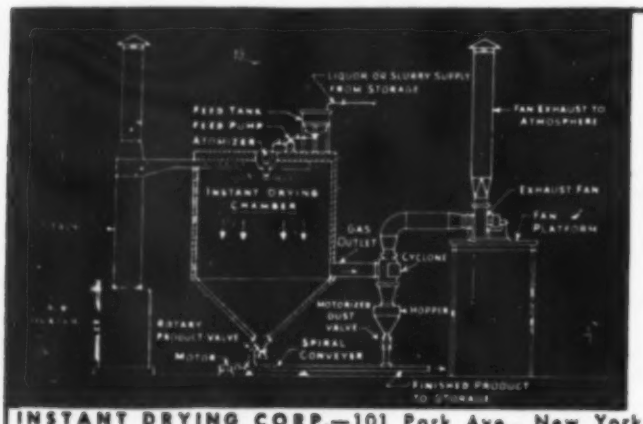

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30 figures and 22 tables. Eight of the figures are excellent color plates reflecting a high degree of skill in color photography. Some readers may find disconcerting the odd device of accenting topics by centering fragments of sentences on the page in bold faced type.

In the introduction, Dr. Krumbhaar points out that his book is a technological study, not a textbook. This probably explains the lack of any references to sources of other basic work in the field. Nevertheless the value of the book to the student would be immeasurably increased if some bibliography had been included. However, the volume is highly recommended to all technologists working in the field of synthetic resins, either as producers or consumers. It is probable that the book will prove notably provocative and stimulating. It is certain to provide a wealth of fruitful suggestions for additional research.

RECENT BOOKS and PAMPHLETS

A Quarter Century of Pioneering. Published by the Cooper Alloy Foundry Co., Hillside, N. J. 44 pages. A pictured discussion of the growth of the Cooper company. Use of stainless steel castings by various industries is illustrated. Includes three pages of data on physical properties, corrosion resistance and high temperature properties.

Rubber Developments. Vol. 1, No. 1. Published by the British Rubber Development Board, London E. C. 3, England. 40 pages. Gratis. Contains articles covering such subjects as rehabilitation of the rubber estates in Malaya, Positex and latex.

Classified Directory. Eleventh edition. Published by the Association of Consulting Chemists and Chemical Engineers, Inc., 50 East 41st St., New York 17, N. Y. 120 pages. A summary of the background, scope and activities of the various firms represented by the members of the association.

Wax and Fatty Byproducts from Sugarcane. By Royal T. Balch. Technological Report Series No. 3, published by the Sugar Research Foundation, New York, N. Y. 62 pages. Gratis. A review of the existing knowledge concerning the wax and fatty materials present in cane.

What Makes Workers Work? By James F. Lincoln. Published by Liberty Library, Fair Lawn, N. J. 32 pages. 25 cents. An address given before the Canadian Club of Toronto and the question and answer period which followed it.

The State of the Company. Published by the Timken Roller Bearing Co., Canton, Ohio. 214 pages. Fifty-three radio talks each covering a different phase of the Timken Roller Bearing Co.'s operation.

Reverse Cycle Refrigeration for Heating in the South. Bulletin No. 14—June, 1947. By S. P. Goethe. Published by Florida Engineering and Industrial Experiment Station, University of Florida, Gainesville, Fla. 48 pages. Gratis. Principles of reverse cycle refrigeration and its use in the South.

The Enameler's Dictionary. Published by the Ferro Enamel Corp., Cleveland, Ohio. 84 pages. Glossary of 1,200 porcelain enameling terms. Includes reference charts and a running pictorial of the porcelain enameling process.

Industrial Waste Disposal for Petroleum Refineries and Allied Plants. By W. B. Hart. Published by Petroleum Process-

Service Ratings			
Type	Size	Pounds per square inch	
		Steam	Non-Shock Cold WOG
Screwed	¼"–2"	150	225
	2½"–4"	125	175
Flanged	1"–2"	125	200
	2½"–4"	125	175

Fig. 709 Saddle Style — Inside Screw — Bronze Mounted or All Iron

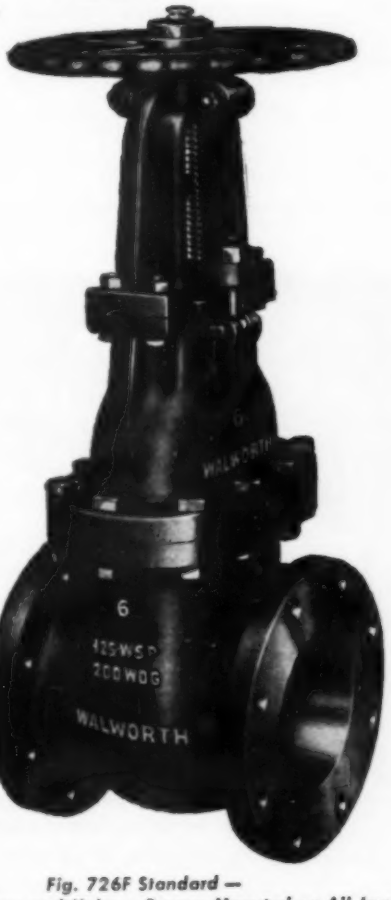

Fig. 726F Standard — Outside Screw and Yoke — Bronze Mounted or All Iron

Service Ratings			
Type	Size	Pounds per square inch	
		Steam	Non-Shock Cold WOG
Screwed or Flanged	2"–12"	125	200
	14"–16"	125	150
	16" and larger	*	150

* For steam service requiring valves 18" and larger we recommend the use of Walworth 150-Pound Cast Steel Valves.

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Fig. 719 Standard — Non-Rising Stem — Bronze Mounted or All Iron

Service Ratings			
Type	Size	Pounds per square inch	
		Steam	Non-Shock Cold WOG
Screwed or Flanged	2"–12"	125	200
	14" and larger	125	150

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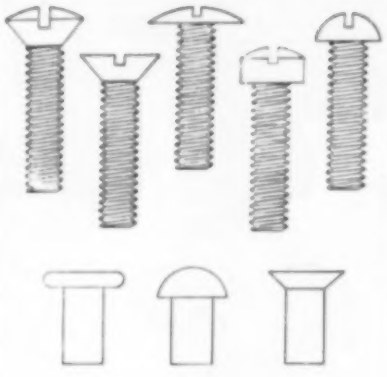

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Aniline. Chemical Safety Data Sheet SD-17, published by Manufacturing Chemists' Association, 608 Woodward Building, Washington 5, D. C. 12 pages. 20 cents. Information on the safe handling and use of aniline.

Phosphorus, Elemental. Chemical Safety Data Sheet SD-16. Published by Manufacturing Chemists' Association, 608 Woodward Building, Washington 5, D. C. 16 pages. 20 cents. Discusses properties and handling of elemental phosphorus.

GOVERNMENT PUBLICATIONS

The following recently issued documents are available at prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. In ordering publications noted in this list always give complete title and the issuing office. Remittances should be made by postal money order, coupons or check. Do not send postage stamps. When no price is indicated, pamphlet is free and should be ordered from the bureau responsible for its issue.

Problems of Long-Distance Transportation of Natural Gas. Federal Power Commission, Natural Gas Investigation (Docket No. G-580), November 1947. Mimeographed. Economic study significant as to future of industrial fuel.

Industrial Injuries to Women. Women's Bureau, Bulletin No. 212. Price 10 cents.

Safe Practices Around Electrical Equipment. U. S. Department of Labor, Industrial Safety Charts—Series V. Price 5 cents. Charts suitable for plant use.

Analysis of Geneva Draft of Charter for an International Trade Organization. U. S. Tariff Commission, November 1947. Mimeographed. Describes basis of current conference at Havana.

Mining and Manufacturing Industries in Cuba. U. S. Tariff Commission. Price 20 cents. One of a series of reports on mining and manufacturing industries in the American Republics.

Printed Circuit Techniques. By Cledo Brunetti and R. W. Curtis. National Bureau of Standards Circular 468. Price 25 cents. Applicable to plant instrument control problems.

Directory of Commercial and College Laboratories. National Bureau of Standards, Miscellaneous Publication M187. Price 30 cents.

Electrical Characteristics of Dry Cells and Batteries. National Bureau of Standards, Letter Circular LC877. Mimeographed. Basis for standard specifications recommended for both government and industry use.

Selection, Installation, and Care of Linoleum. By G. G. Richey. National Bureau of Standards, Letter Circular LC879. Mimeographed. A practical aid for industrial users.

List of Commercial Standards. National Bureau of Standards, Letter Circular LC878. Mimeographed. List revised to Oct. 1, 1947 of recommended commercial standards.

Grinding Wheels. National Bureau of Standards, Simplified Practice Recommendation R45-47. Price 15 cents. A schedule of specifications for grinding wheels.

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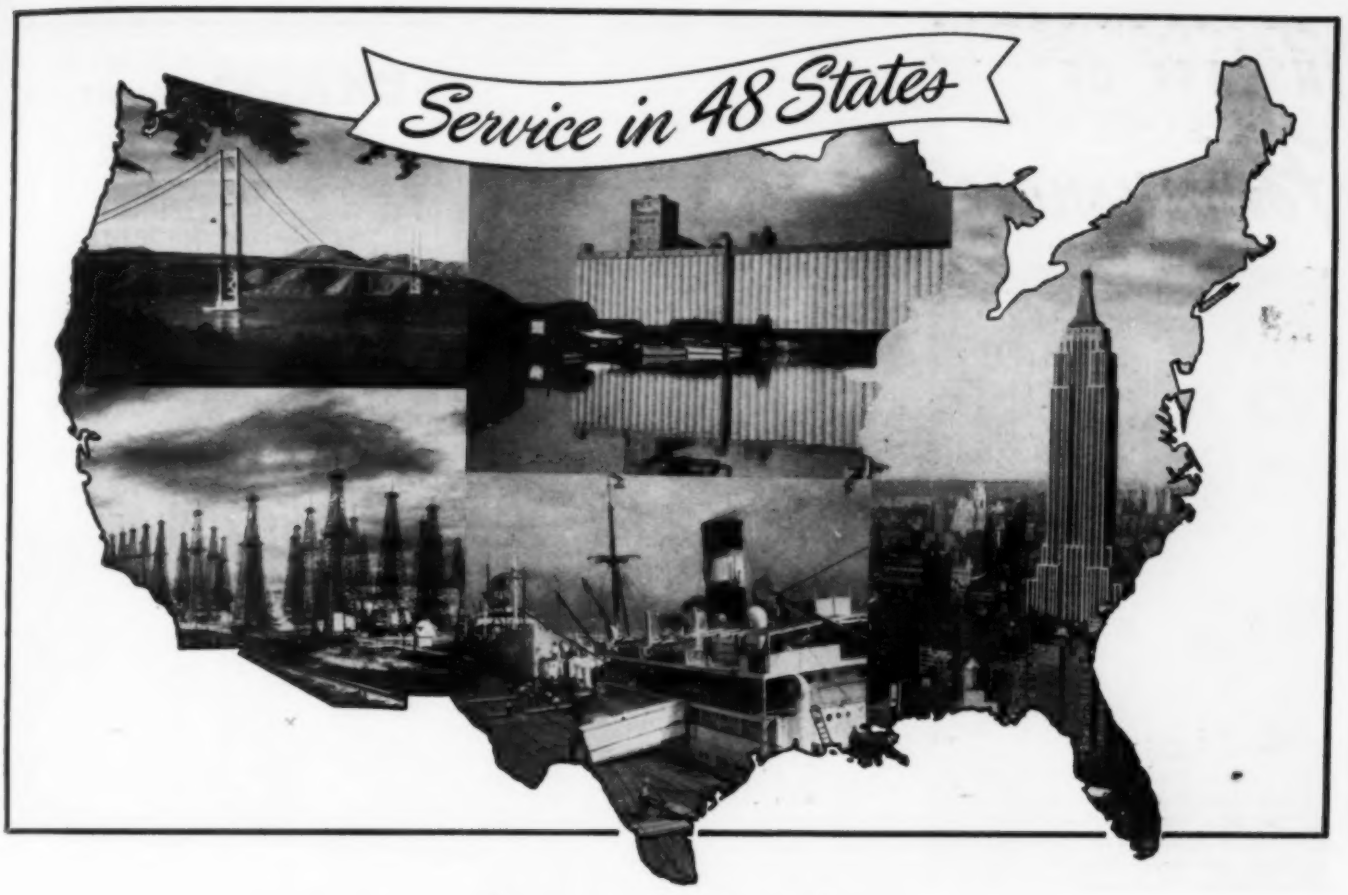

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of commercial standards includes: CS20-47, Staple vitreous china plumbing fixtures, 10 cents; CS35-47, Hardwood plywood, 10 cents; CS129-47, Materials for safety wearing apparel, 5 cents.

Annotated Bibliography of Subtilin. By J. C. Lewis. Western Regional Research Laboratory, Albany, Calif. AIC-168. Mimeographed.

Fats and Oils in World War II—Production and Price Supporting Programs. Bureau of Agricultural Economics, Department of Agriculture, War Records Monograph 6. Processed.

Foreign Aid Reports. Executive Department investigations on which the President has based his requests to Congress are available as follows:

(a) National Resources and Foreign Aid. Report of J. A. Krug, Secretary of the Interior. Price 60 cents. Discusses principally mineral reserves and products therefrom as related to foreign requests.

(b) European Recovery and American Aid. A three-part report of the Harriman committee. Price 60 cents. Summarizes in two volumes relation of foreign requests to American needs and output.

(c) Committee on Foreign Aid (Herter Committee). The summaries of preliminary reports dealing with various foreign situations and with certain suggested problems, including Report Four, Fertilizer Requirements and Availabilities; Report Five, Petroleum Requirements and Availabilities; Report Six, United States Steel Requirements and Availabilities; Report Seven, Coal Requirements and availabilities; Report Nine, Break-Down of European Requirements by Major Catagories; and Report Ten, Foreign Aid and Exhaustion of Natural Resources in Relation to a Stock Piling Program. Individual leaflets available from House of Representativea Select Committee on Foreign Aid.

Trade Agreements. Complete record of changes in tariffs granted by and to United States is available only through United Nations publication of four volumes, price $5 per set; order from International Documents Service, Columbia University Press, 2960 Broadway, New York, 27. U. S. Government has issued two documents only:
(a) Analysis of General Trade Agreement. Department of State Publication 2983. Price 50 cents.
(b) Schedule XX—Modified Rates of Duty, Most-Favored-Nation Tariff. Bureau of Customs, Treasury Department. Price 50 cents.

Committee of European Economic Cooperation. Volume II, Technical Reports, Department of State Publication 2952. Price $1. (Vol. I announced last month.)

Prophyllite Resources in Japan. Bureau of Mines, Mineral Trade Notes, Special Supplement No. 17 (to Vol. 25, No. 2). Mimeographed.

Determination of Carbon Monoxide by Absorbtion in the Haldane-Type Gas-Analysis Apparatus. By L. B. Berger, Bureau of Mines, Report of Investigations R. I. 4187. Mimeographed.

Gasification of Solid Fuels in Germany by the Lurgi, Winkler, and Leuna Slagging-Type Gas-Producer Processes. By William W. Odell, Bureau of Mines, Information Circular I. C. 7415. Mimeographed.

Recovery of Alumina from Wyoming Anorthosite by the Lime-Soda-Sinter Process. By R. A. Brown, et al. Bureau of Mines, Report of Investigations R. I. 4132. Mimeographed.

Specific Heat of Colorado Oil Shales. By R. J. Shaw, Bureau of Mines, Report of Investigations R. I. 4151. Mimeographed.

Concentration of Fluorite Ores from Arizona, California, Idaho, Montana, Nevada, and Wyoming. By J. V. Batty, et al. Bureau of Mines, Report of Investigations R. I. 4133. Mimeographed.

Concentration of Colorado Fluorite Ores. By J. V. Batty, et al. Bureau of Mines, Report of Investigations R. I. 4139. Mimeographed.

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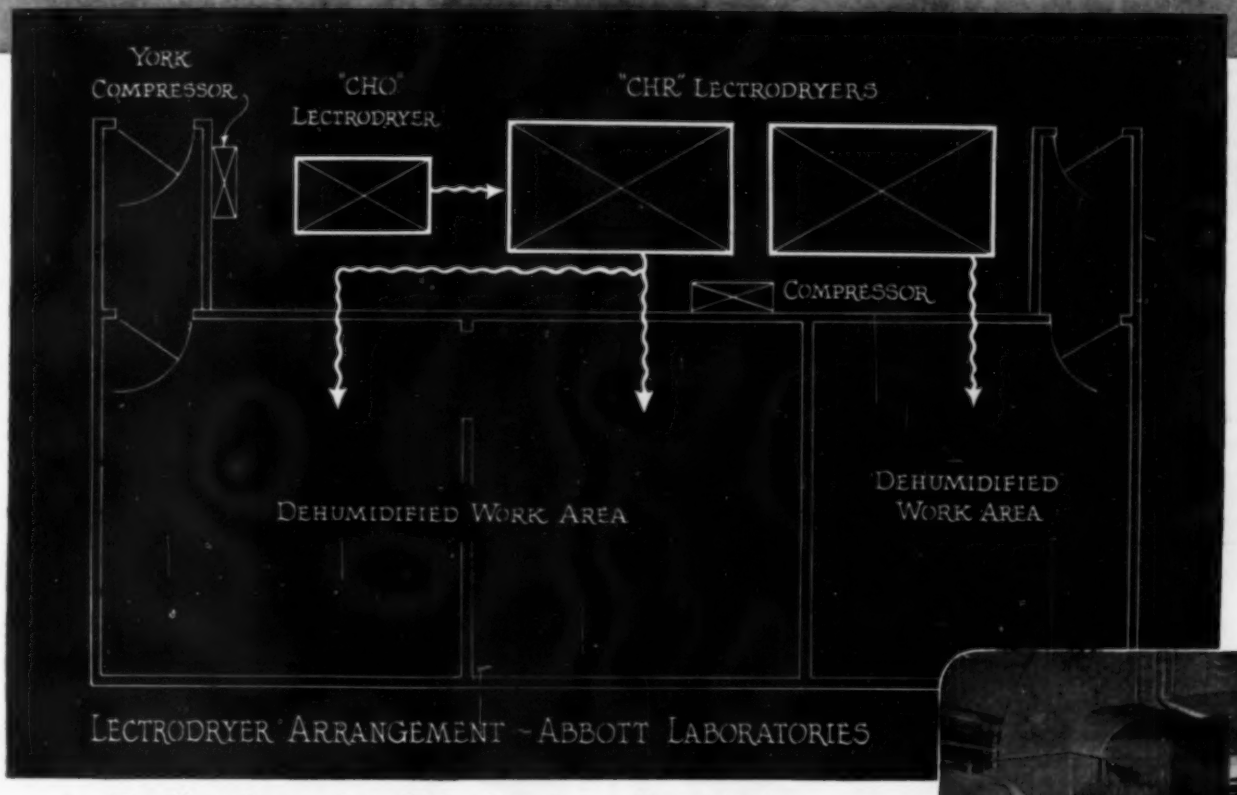

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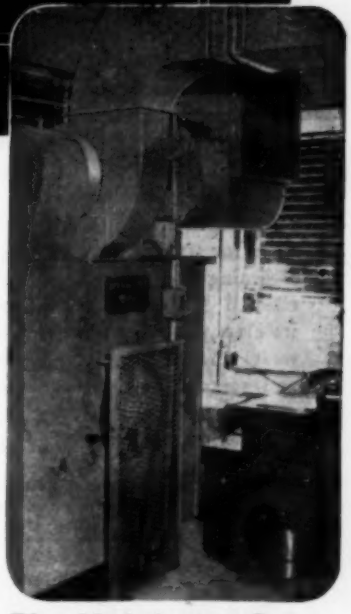

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(Continued from page 170)

steam-atomizing oil burners made by this company and their combined gas and oil burners for industrial boilers, heaters and furnaces.

112. Ion Exchange. American Cyanamid Co., New York.—12-page booklet discusses this company's ion exchange process for processing sugar juices.

113. Glass Fibers. Glass Fibers Inc., Waterville, Ohio.—8-page brochure describing the manufacture of glass fibers by this company.

114. Coal Tar Chemicals. Reilly Tar & Chemical Corp., Indianapolis, Ind.—Two booklets describing this company's coal tar chemicals and their applications. 54-page booklet describes chemicals. Includes data on purity, distillation range, solubility and uses. 16-page booklet describes the protective coatings and preservatives made by this company.

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116. Metal Accessories. Tool Steel Gear & Pinion Co., Cincinnati, Ohio—4-page bulletin illustrates and describes the sheaves and pins made by this company.

117. Rubber Joints. Hamilton Kent Manufacturing Co., Kent, Ohio—4-page booklet illustrates the rubber joints made by this company. Contains photographs showing applications.

118. Metal Powders. New Jersey Zinc Co., New York—4-page leaflet illustrates and describes the metal powders made by this company. Discusses applications.

119. V-Belts. B. F. Goodrich Co., Akron, Ohio—2-page flyer describes construction of this company's V-belts. Carries a page of tables giving data on standard stock sizes.

120. Rubber Chemicals. J. M. Huber Corp., New York—4-page leaflet describing this company's bloom inhibitor for natural rubber and mixtures of natural rubber and GR-S compounds.

121. Heat Treating. Surface Combustion Co., Toledo, Ohio—24-page booklet discusses appliances and equipment made by this company for use in many types of industrial heat treating.

122. Rubber Antioxidant. Benson Process Engineering Co., Eden, N. Y.—1-page flyer describing this company's antioxidant for rubber, paint and plastics.

123. Equipment. Schmieg Industries Inc., Detroit, Mich.—12-page loose-leaf booklet illustrating and describing the equipment for dust and fume elimination made by this company. Contains six pages of blueprints of the various models.

124. Materials Handling. George G. Rodgers Co., New York—4-page folder illustrating and describing this company's equipment for filling packages. Lists specifications.

125. Magnetic Separators. Dings Magnetic Separator Co., Milwaukee, Wis.—12-page catalog describing rectangular

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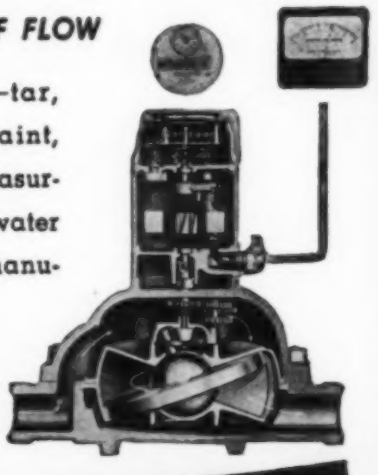

For practically all liquids—tar, molasses, crude oil, grease, paint, varnish, syrups, etc., etc.—for measuring, indicating, totalizing flow of water and chemicals in continuous manufacturing processes and numerous other uses. Its remote indicating feature is new—get the complete story.

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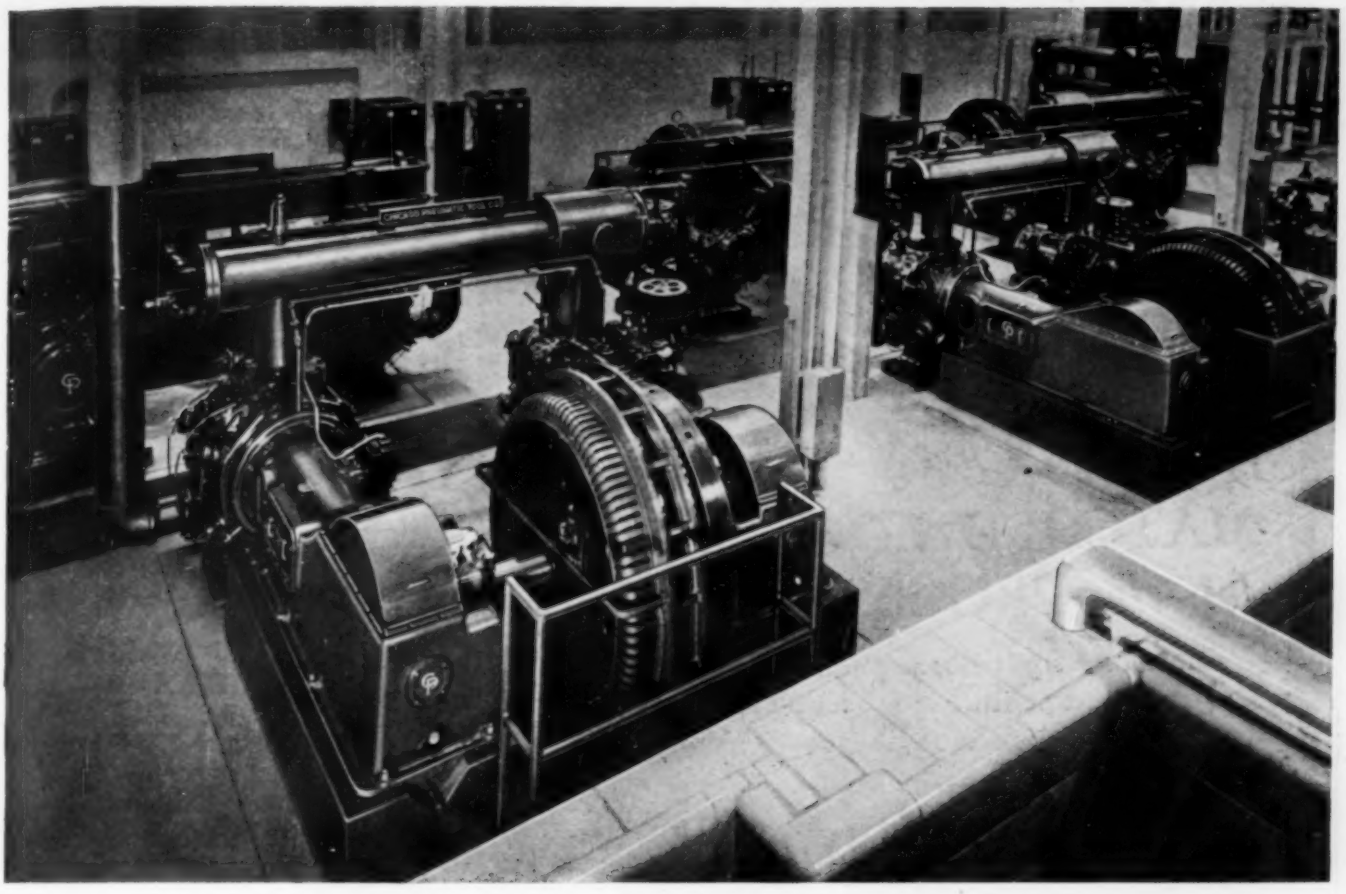
The HAYS CORPORATION

COMBUSTION INSTRUMENTS AND CONTROLS

MICHIGAN CITY, INDIANA, U.S.A.



for continuous heavy-duty and economical operation

O-CE Compressors

Rugged construction, conservative rating, and low power consumption make the CP motor-driven Class O-CE the ideal compressor for the continuous, heavy-duty job.

- Quick-acting Simplate valves minimize power consumption, and provide high volumetric efficiency.
- Large, streamlined air passages make air flow resistance negligible.
- CP Multi-step Control handles partial load demands with maximum economy.
- CP Intercooler assures maximum heat transfer with low water consumption.
- CP Automatic Starting Unloader completely unloads compressor when starting and stopping.

The CP Class O-CE Compressor is of the horizontal, double-acting, water-cooled type, with direct-mounted synchronous motor drive. Furnished in sizes up to 1,500 h.p., for pressures up to 5,000 pounds. Write for full information.

CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 8 East 44th Street, New York 17, N. Y.

AIR COMPRESSORS • ELECTRIC TOOLS • PNEUMATIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

Products that stand the test of Time...

HARDINGE
MATCHED EQUIPMENT
for the PROCESS *Industries*

Behind every Hardinge product stands forty years of experience in producing long-lived, matched equipment for the process industries —gauged to the job.

CONICAL BALL MILLS
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"AUTO-RAISE" THICKENERS
CLARIFIERS
AGITATORS
AUTOMATIC BACKWASH RAPID SAND FILTERS
STANDARD SAND FILTERS
RUGGLES-COLES ROTARY DRYERS (nine types)
RUGGLES-COLES ROTARY KILNS
RUGGLES-COLES ROTARY COOLERS
KEYSTONE LIME KILNS
CONSTANT-WEIGHT-FEEDERS
WEIGHT-RECORDING FEEDERS
DISC FEEDERS
DRUM FEEDERS
NON-FLOODING FEEDERS
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DIAPHRAGM PUMPS
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BATCH MILLS
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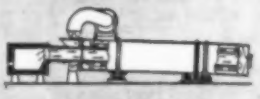
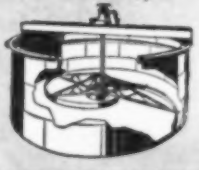


ROTARY DRYER



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COUNTER-CURRENT CLASSIFIER

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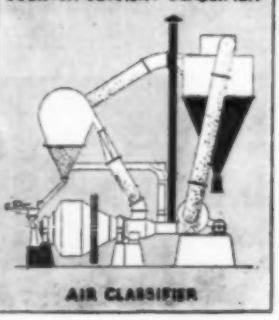


AIR CLASSIFIER

double-gap electromagnetic, suspended, spout and plate magnets and wet type magnets for submerged installations. Discusses construction and applications. Contains charts giving dimensions and weights.

126. Diesel Engines. Ingersoll-Rand, New York—4-page leaflet illustrating and describing this company's line of diesel engines. Contains a cross-sectional diagram of the engine. Lists ratings and dimensions.

127. Zinc Dust. American Smelting and Refining Co., New York—Pamphlet discusses the applications and characteristics of zinc dust.

128. Metal Specialties. Metal Carbides Corp., Youngstown, Ohio—8-page catalog contains prices and specifications on carbide metal products manufactured by this company. Standardized carbide shapes are available for a variety of applications.

129. Electronic Equipment. John T. O'Connor & Co., West Orange, N. J.—4-page leaflet illustrating and describing the special machinery, machine process controls and electronic equipment made by this company. Discusses typical applications and operating principles.

130. Metallizing. Metallizing Engineering Co., Inc., Long Island City, N. Y.—16-page booklet describing applications in which this company's metal coatings and coating equipment were used successfully.

131. Hydraulic Pumps. Hydro-Power, Inc., Springfield, Ohio—4-page flyer illustrating and describing the line of hydraulic pumps made by this company.

132. Lubrication Equipment. Lukenheimer Co., Cincinnati, Ohio—12-page pocket-sized folder illustrating and describing this company's bottle oilers for automatic lubrication of machinery. Contains installation photographs. Lists prices and dimensions.

133. Materials Handling. Rapids-Standard Co., Inc., Grand Rapids, Mich.—2-page flyer showing prices and specifications of the aluminum conveyor made by this company. Gives construction details. Illustrates details of the conveyor frame.

134. Rubber Belting. Hewitt-Robbins Inc., Buffalo, N. Y.—Folder describes the conveyor belting made by this company. Discusses construction features.

135. Welding. Eutectic Welding Alloys Corp., New York.—8-page booklet describes procedures in industrial equipment salvage welding.

136. Control Valves. Foxboro Co., Foxboro, Mass.—Bulletin 277-2. 36-page booklet illustrates and describes the line of control valves made by this company. Contains tables of specifications and information for computing valve sizes.

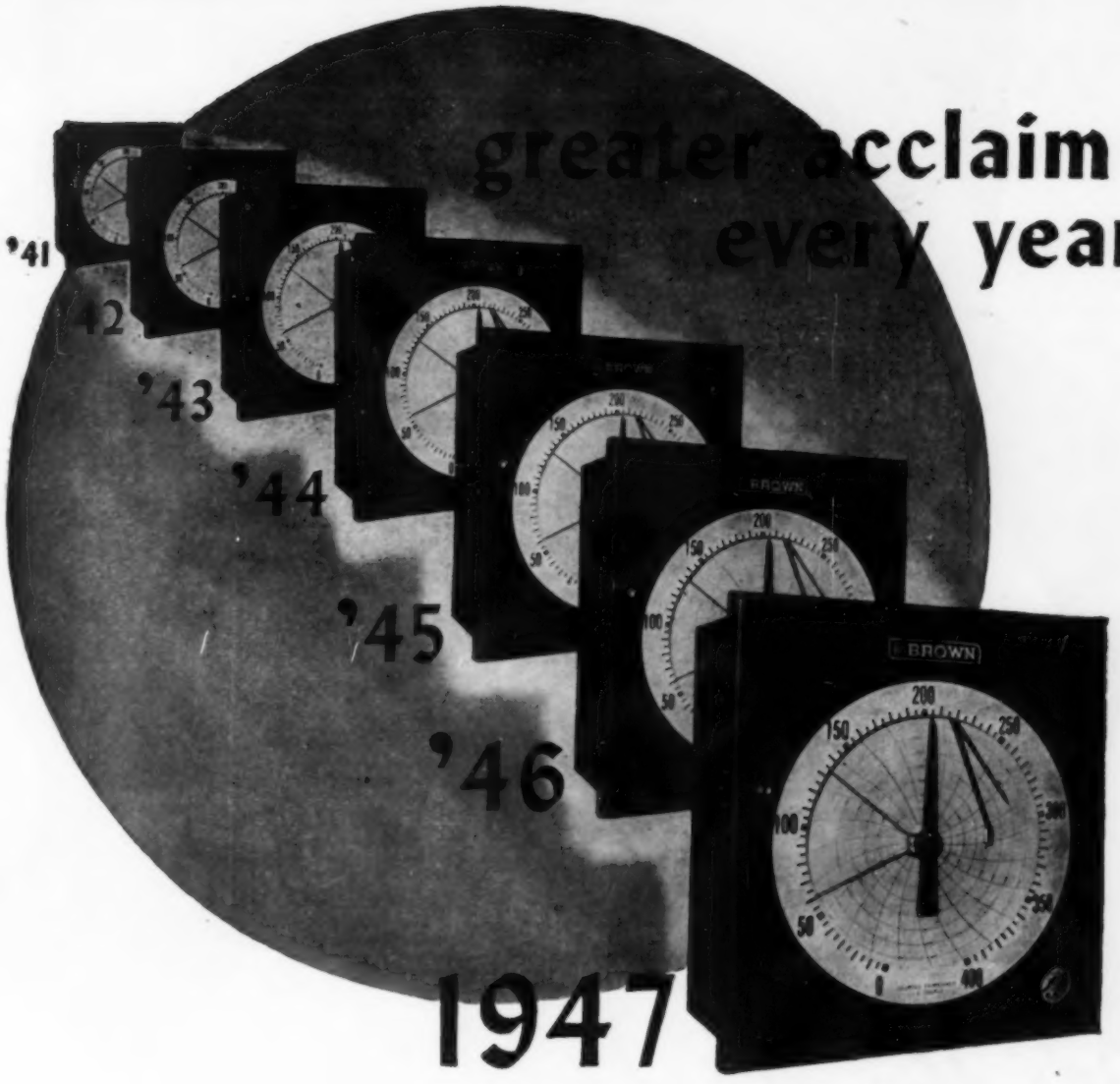
137. Chemicals. Heresite & Chemical Co., Manitowoc, Wis.—36-page booklet describing and illustrating the plastic coatings, synthetic resins and molding compounds made by this company. Lists physical properties of several of the coatings. Contains photographs of applications.

138. Protective Clothing. Industrial Products Co., Philadelphia. — 4-page folder describing and illustrating the protective aprons, sleeves, gloves made for industrial use. Includes prices and sizes. Mentions other safety devices made by this company.

139. Equipment. Perfektum-Products Co., New York.—4-page folder describes and illustrates this company's equipment for washing, filling and sealing bottles and ampules.

140. Alloys. Ampco Metal, Inc., Milwaukee, Wis.—1 loose-leaf page describing an aluminum bronze type alloy made by this company. Lists its physical characteristics.

141. Instruments. Pyrometer Instrument Co., New York.—4-page leaflet describing the surface pyrometer made by this company. Contains photographs of the instrument with various attachments.



ElectroniK performance proved . . . by *Seven years* in chemical service.

Each year industry accords greater acclaim to the Brown *ElectroniK* Potentiometer. Reviewing the record —seven years ago these "acclaims" were merely *claims* for a new and revolutionary type instrument.

In 1941 the story of the Brown *ElectroniK* was almost unbelievable. Today it is a proven reality backed by an unparalleled performance record.

Time has proven another important fact—the Brown *ElectroniK* Potentiometer requires only *negligible maintenance*. This fact alone is the reason why hundreds of plants have standardized on the Brown *ElectroniK*. Increasing purchases by previous users is gratifying proof to the men who have designed and manufactured this instrument.

Every year further substantiates the fact that the Brown *ElectroniK* Potentiometer is the most remarkable industrial instrument development of the decade.

THE BROWN INSTRUMENT CO., 4478 WAYNE AVE., PHILADELPHIA 44, PA.
DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.

Subsidiary Companies in Toronto • Mexico City • London • Stockholm • Amsterdam • Brussels • Zurich

BROWN *Advanced Instrumentation* FOR BETTER PROCESSING

Product of MINNEAPOLIS Honeywell

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY

313 WILSON, SO. NORWALK, CONN.

H. M. Batters, MARKET EDITOR

PHENOL—A Market Study

Chemical Engineering ***is starting a series of commodity studies this month. Each article in the series will consider a chemical or class of chemicals. It will endeavor to show who makes it, where it is used, how much is made, and how much it costs. It will discuss the current market and the outlook.***

PHENOL is in short supply in spite of a rapid growth in production. A look at the phenol consumption pattern shows the reason. The largest consumer of phenol is the synthetic resin industry. More than 53 thousand tons of phenol went into production of phenolic resins in 1944. In 1946 more than 57 thousand tons went into phenol-formaldehyde resins. This was more than 56 percent of phenol output. In spite of an estimated 133 thousand tons of phenol produced in 1947, phenolic resin producers want more phenol.

Chemical production, which includes substituted phenols, is the second largest consumer. Petroleum refining consumes about 4 percent of current output while disinfectants and insecticides, plasticizers and toluene extraction each take 2 or 3 percent.

Estimated Phenol Consumption Pattern

	Percent of Production
Resins	60
Chemicals	13
Petroleum	4
Disinfectants and Insecticides	3
Plasticizers	2
Toluene extraction	2
Dyes and inks	1
Miscellaneous	15
Total	100

Producers of synthetic phenol, as a result of war and postwar expansion programs, will have an estimated production capacity of 290 million pounds a year. In addition to this capacity there is an annual capacity of natural phenol that amounts to 30 million pounds.

According to the U. S. Tariff Commission there are five producers of natural phenol. They are: Reilly Tar & Chemical Corp.; Calco Chemical Division, American Cyanamid Co.; Koppers Co.; Republic Creosoting Co.; and Barrett Division, Allied Chemical & Dye Corp.

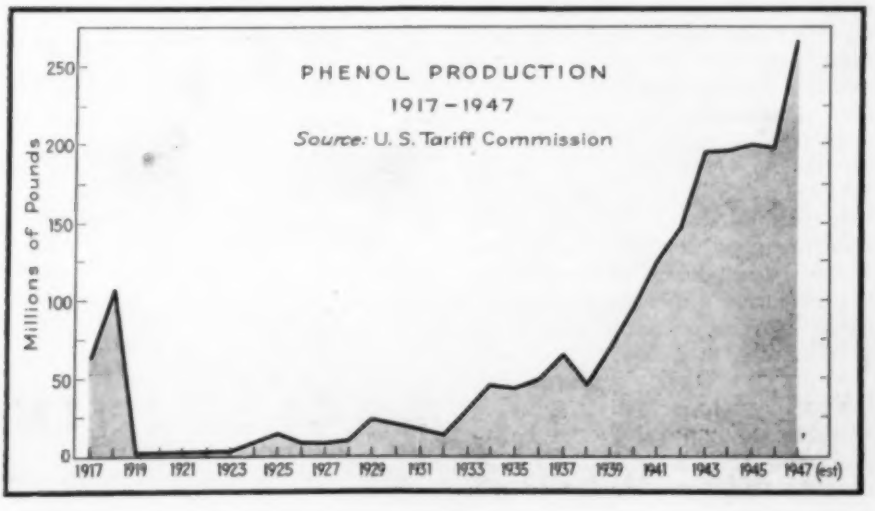
The existing production pattern leaves the burden of supplying the largest part of industrial needs up to producers of synthetic phenol. They in turn are faced with a shortage of caustic soda and a potential shortage of benzene. Shortages of caustic soda have hampered output of several basic chemicals during the postwar period and phenol producers have, of course, felt this pinch. Even if shortages of raw materials were relieved, present phenol capacity would be hard pressed to meet the constantly growing demand for this material. However, there is a potential limiting factor in the amount of benzene that can be produced as a byproduct of the steel industry with its present equipment, and as long as the bulk of benzene is obtained from byproduct operations this limiting factor will exist. If the petroleum industry expands its output of benzene this can be removed.

Chemical industry depends on the steel industry for its benzene, since most of it is produced as a byproduct of coke operations. Coal is not normally processed for coal chemicals alone, so demand for coke controls the amount of benzene available. Phenol production consumed about 35.5 million gallons of benzene in 1947. In 1946 it consumed 25.8 million gallons. The problem facing the coal chemical industry is one of constantly expanding demand and fixed maximum amount of benzene from coke oven operations. Some authorities estimate this peak production at about 150 million gallons. There is more than enough productive capacity of polystyrene, GR-S, phenol, dyes and other chemicals to use all of this amount. Benzene from petroleum will therefore be a growing factor in satisfying any expansion in the future.

A look at the past shows that with

Synthetic Phenol Producers

Company	Plant	Method
Barrett Division, Allied Chemical & Dye Corp.	Frankford, Pa..	Caustic Fusion
Monsanto Chemical Co..	St. Louis, Mo..	Benzenesulphonate
ReichholdChemicals, Inc.	Tuscalloosa, Ala	Benzenesulphonate
Solvay Process Co.....	Syracuse, Ala...	Benzene Oxidation
Dures Plastics andChemical Co.....	N. Tonawanda, N. Y.....	Regenerative Hydrolysis of Chlorbenzene
Dow Chemical Co.....	Midland Mich.	Hydrolysis of Chlorbenzene
General Electric Co.....	Pittsfield, Mass	Hydrolysis of Chlorbenzene
Heyden Chemical Co....	Memphis, Tenn.....	Hydrolysis of Chlorbenzene



increased demand in World War I, output of phenol reached 107 million pounds in 1918. Prior to 1914, production averaged 1 million pounds per year. After the war, stocks totaled almost 40 millon pounds. This was estimated to be three times the annual consumption for non-military purposes at that time. Therefore, the price dropped from 45c. to 6c. per lb. and synthetic plants were closed. By 1923 the price had risen to 27c. per lb. and from that time the price has dropped steadily until it has reached a level of 11c. Rising fuel costs have threatened the supply of natural phenol and other tar acids. Tar burned as fuel cannot be distilled and as fuel costs rise more tar will be substituted for regular fuels.

Phenol, the building block of a large part of the synthetic resin industry, will not be in free supply in the immediate future. Planned capacity may meet industry's needs but availability of raw materials will control the future supply.

FIRST QUARTER REQUIREMENTS FOR CHEMICALS LARGE ENOUGH TO FORCE A NEW HIGH IN PRODUCTION

PRODUCTION and consumption of chemicals which earlier appeared to have leveled off, started on a new upward course in the final quarter of last year which has carried into the present months with the apparent certainty that activities in the first three months of this year will be of record-breaking proportions. Objectives have been made public by several industries which rate high as consumers of chemicals and they offer a basis for converting anticipated manufacturing activities into equivalent requirements for raw materials.

By way of illustration, demands for fertilizer materials are larger than in any past period and productive capacities are higher than ever before, so it is difficult to visualize any happening which could change the basic situation so far as the immediate future is concerned. To a greater or less degree the same conditions apply to pulp and paper, petroleum refining, rayon, steel, coal products, and plastics. Apparently current rate of operations in the chemical-processing industries is about 5 percent above that of a year ago and the outlook is favorable for maintaining that differential throughout the quarter.

Although considerable progress was made last year in the way of bringing raw material supplies in closer harmony with consuming requirements, maximum production of many finished products still is checked because many important chemicals are not available in sufficient volume. In the case of soda ash, the supply position is expected to improve in the next few months with new capacities coming into operation but it is probable that this chemical will be in a tight position throughout the year. Caustic soda is another material which has not been brought into balance and this in turn limits the output of phenol and a wide variety of finished products.

With most outside countries pushing up their production levels and attempting to improve their exchange position by reserving a high percentage of outputs for export, the recently effected international agreements on tariffs and trade may have a two-way effect on domestic production. In the first place, export trade may be expanded in some directions and secondly, competition from foreign raw materials and finished products may be expected to grow progressively. Some tariff adjustments became effective as of January 1, others will become operative at a later date. For the immediate future, there is little probability that foreign trade developments will have any disturbing effect on domestic production and distribution. From a longer-term viewpoint there is no cause for alarm in the prospect of foreign competiton in chemicals but some of the products which consume chemicals may be in a more vulnerable position.

Other factors which may be classed as unfavorable for full production are found in transportation problems beginning with packaging for shipment. Drums are far from plentiful and shortages of box cars and tank cars are still to be overcome. These conditions are not new and did not prevent a record outturn of chemicals last year and they should not stand in the way of greater achievement in the current year.

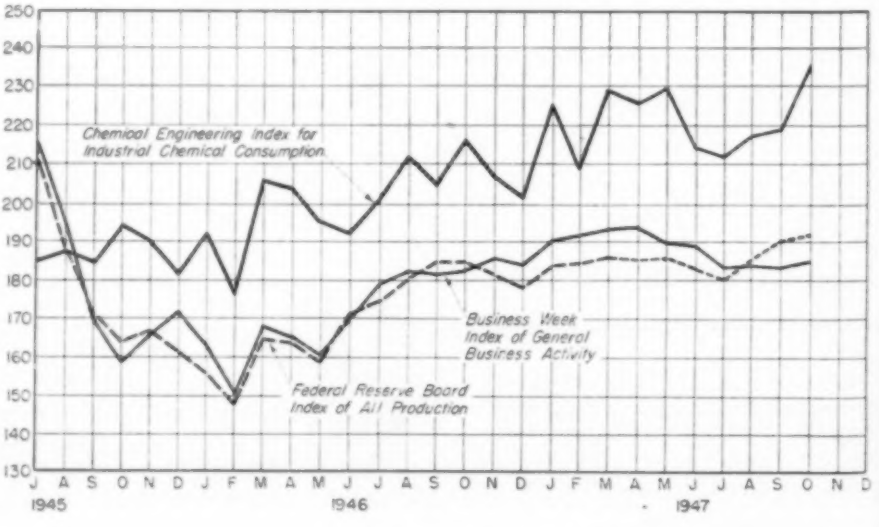
Prices for chemicals were strongly entrenched last year with the majority of revisions favoring the up side. *Chemical Engineering* weighted index for chemical prices stood at 121.63 last January and by December had moved up to 128.52. In nearly all cases the higher price levels represented an adjustment forced by increased production costs. The upward trend still is in evidence with prospects that further enforced corrections will be made on several commodities for second-quarter deliveries. Higher transportations costs also will add to delivered prices this year. Oils and fats showed a wide price range. In January the weighted price index was 303.82, moved up to 345.62, the high for the year, in April and then started to drop with marketing of new crop oilseeds bringing the figure down to 200.79 in September but a rapid recovery was staged in the closing months with December standing at 309.01.

***Chemical Engineering* Index**

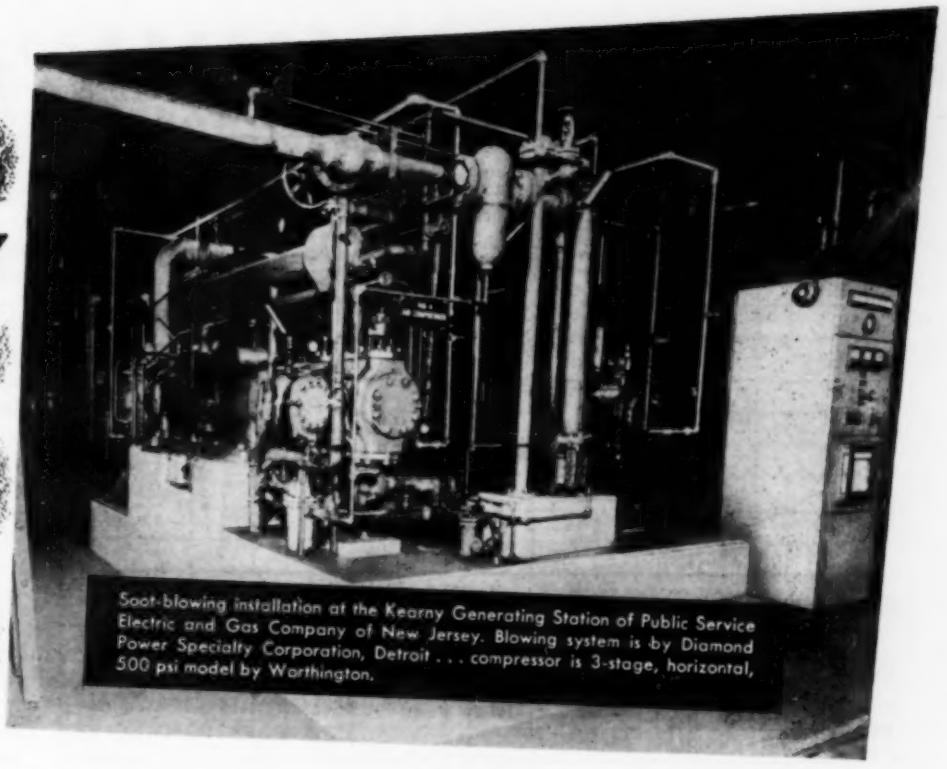
Industrial Consumption of Chemicals

1935 = 100

	Sept. Revised	Oct.
Fertilizers	48.59	53.54
Pulp and paper	21.92	24.39
Petroleum refining	20.62	21.03
Glass	21.43	22.25
Paint and varnish	23.78	24.95
Iron and steel	12.42	13.69
Rayon	23.24	25.16
Textiles	10.40	11.56
Coal products	10.20	11.00
Leather	5.05	5.25
Explosives	8.16	8.70
Rubber	5.50	5.75
Plastics	7.40	8.55
	218.71	235.82



FOR TOP EFFICIENCY IN SOOT BLOWING



Soot-blowing installation at the Kearny Generating Station of Public Service Electric and Gas Company of New Jersey. Blowing system is by Diamond Power Specialty Corporation, Detroit . . . compressor is 3-stage, horizontal, 500 psi model by Worthington.

WORTHINGTON COMPRESSORS MAKE A CLEAN SWEEP

Correct boiler cleaning is yours . . . at a saving in labor . . . when you put an automatic, compressed-air soot-blowing system to work. Compressed air as a cleaning medium offers savings in fuel and savings in feed-water make-up. In addition, the possibility of tube erosion is reduced because condensate is not present in the blowing medium.

SOOT BLOWING AT KEARNY GENERATING STATION

At the Kearny Generating Station of the Public Service Electric and Gas Company, N. J., boiler cleaning became increasingly important, due to a rise in the ash content of the coal. Soot blowing with steam resulted in erosion of the tube surfaces. In addition, the replacement of water removed from the system required chemical treatment and pre-heating.

Compressed-air soot blowing overcame these disadvantages. The Kearny installation operates on an automatic cycle. In the "fog bank" section, four telescopic, long retracting units blow air at about 200 psi over the surface of the tubes, rotating 360 degrees during a projecting and retracting cycle. Short retracting blowers arranged in groups clean the boiler walls and sloping floor.

The booklet, "Worthington Compressors for Soot Blowing" proves *there's more worth in Worthington*. Write for your copy. *Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, New York.*

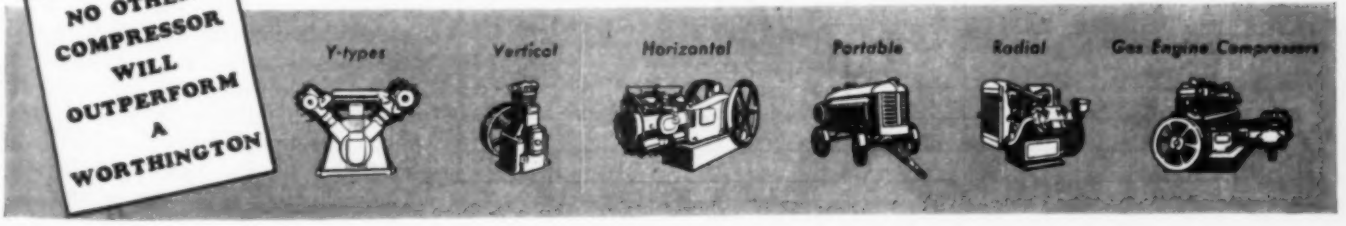
K7.17

ONLY COMPRESSED-AIR SOOT BLOWING GIVES YOU ALL THESE ADVANTAGES

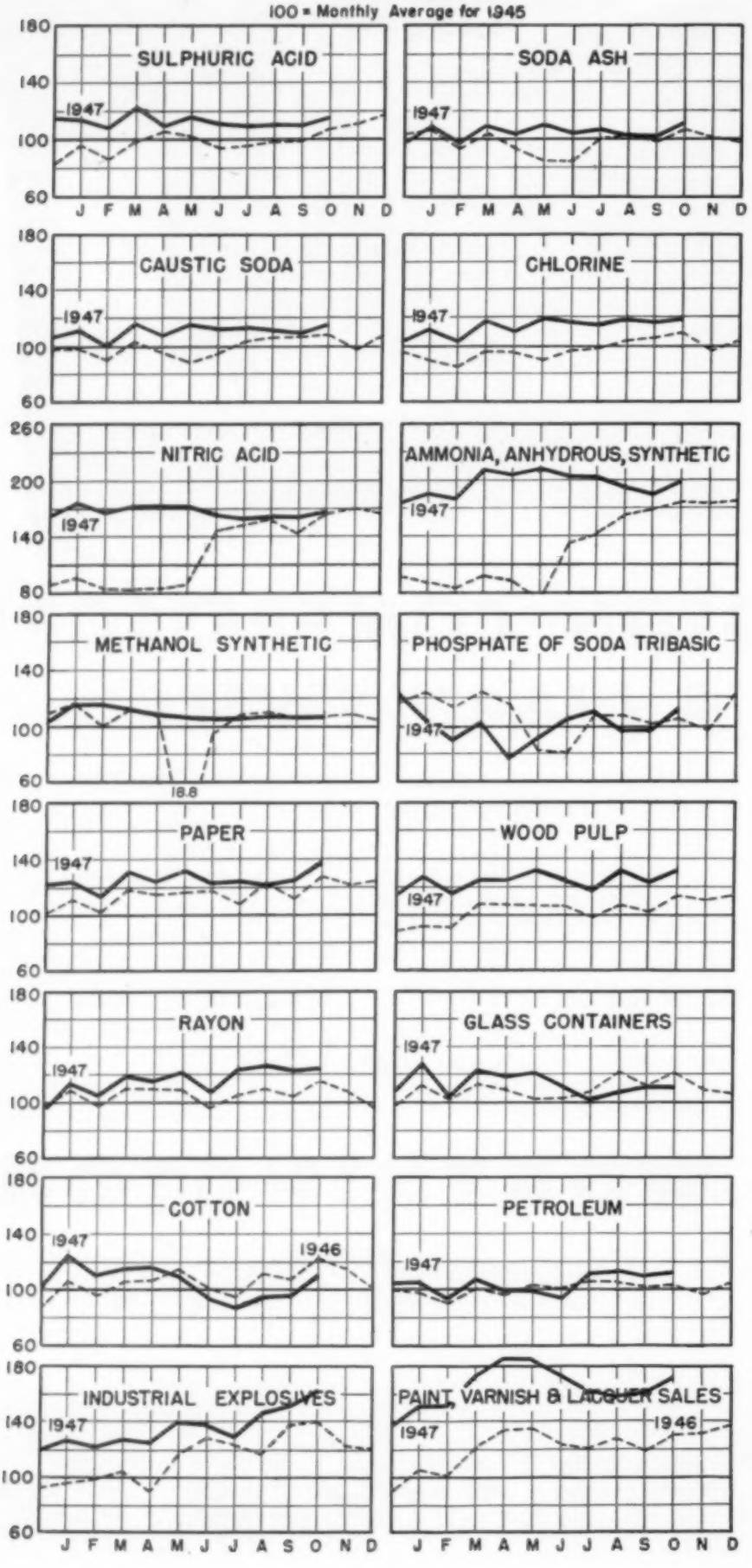
Saves Fuel . . . Saves feed-water make-up . . . Reduces possibility of tube erosion . . . Permits use of lower-cost, low-temperature piping . . . No piping insulation required . . . Reduces soot blower maintenance . . . Dryer blowing medium . . . More effective medium for slag removal.

WORTHINGTON

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



PRODUCTION AND CONSUMPTION TRENDS



When large new ammonia capacities were provided in the war years, primarily to fill military needs, it was generally held that much of this capacity would be surplus when the war was over. That such did not prove to be the case brings into sharp relief the precipitous rise in peacetime requirements for ammonia and its derivatives. In the prewar period, use of ammonium nitrate as a fertilizer material was practically unknown. Last year domestic production ran in excess of 1,000,000 tons the greater part of which was used in the domestic fertilizer industry or shipped abroad for use as fertilizer. When outside countries become more self-supporting and when the domestic fertilizer trade settles into what is an accepted normal, it will be possible to determine how much of this expansion will be permanent. In the meantime there is the possibility of a further trend toward direct soil application of ammonia liquor which has been gaining considerable headway and which may cut in heavily on the market for the nitrate. At any rate it is assured that, in some form, the use of ammonia as a fertilizing agent will remain substantial.

For some years there has been a trend in caustic soda manufacture to place more of the load on the electrolytic product. Last year there was marked rise in over-all production of caustic but it was largely in electrolytic which shows that trend has not been disturbed.

Another large shift in chemical production is found in current outputs of synthetic ammonium sulphate. A few years ago coke-oven plants took care of most requirements for this chemical with chemical companies having an annual output of less than what they are now turning out in a month. Consuming demand has grown to a point where all productive facilities were called upon to contribute more actively to the total.

Salt cake came into its own with the introduction of Kraft mills and the accompanying call for large tonnages of sulphate pulp. Domestic production has not been large enough to satisfy needs and before the war German cake captured a large part of the market. With imports curtailed in recent years there has been an effort to expand home production. There still is not much reliance on outside suppliers and the output of more than 600,000 tons last year must be increased if 1948 needs are to be met.

DORRCO DOINGS IN 1947

Our first year of bi-partisan control since 1933 has passed and brought the first evidence that the labor road is not a "one way street" and that the American people, through their representatives, can rebel against excesses. Every evidence today indicates this is as satisfactory to labor's rank and file as to John Q. Citizen. Elimination of price control, however, with the greatest excess profits going, not to big business, but to the nominally-unorganized farmers, puts the second of our specially-privileged classes in the limelight.

Our country has been united on foreign policies. The great advance of the year has been recognition of the world-wide struggle between an active, controlled ideology, which feels that to survive it must spread, and a brand of Democracy that believes individual freedoms and spiritual standards are worth fighting and living for, and that the power of spirit and good will must triumph in the end. For the "practical" man, an increase in output of over 25 percent at the Victoria Coal Pit in Staffordshire, England, speaks for itself and is credited by the union head to a new spirit of honesty and unselfishness inspired by the "Moral Re-Armament Group."

* * *

ORGANIZATIONAL—Much has been done to improve our "inner workings" and to resume our world-wide coverage in present and anticipated fields.

The Dorr Company really started when, while doing engineering work, the Classifier and Thickener were developed. During the past forty years, much consulting work has been done in our specialized fields. This work has now been formalized by our establishing a Consulting Engineering Department, to focus and make available over 40 years of experience throughout the chemical and metallurgical worlds.

Work of this type exceeded our previous peak year and covered a broad variety of projects, ranging from preliminary studies and economic analyses, through laboratory and pilot plant investigations, to the design and specification of complete plants.

FLUOSOLIDS—The roasting of arseno-pyrite gold concentrates for cyanidation on a commercial scale is now a reality and small scale work in similar fields gives promise of success. A pilot plant operation on a crystalline limestone, in which many unexpected problems were overcome, has resulted in plans for a 100 ton commercial plant, now in the design stage.

CHEMICAL PROCESSING—We have collaborated on plans for the conversion of numerous war-born plants and techniques to peace-time economy, including processing improvements and expansions in such diverse fields as alumina, magnesia, titanium, potash, phosphates and catalysts. Abroad, the highlight was an order for 36 major equipment units to convert the chief Alsatian potash plants from leaching to froth flotation.

CEMENT—Continued activity both here and abroad has been evident. Two new American plants have installed our closed circuit grinding system, and three others have enlarged and improved existing plants with Dorr equipment. Abroad, the further acceptance of Dorr C.C.G. and the thin slurry process has been indicated by equipment supplied for North and South Africa, China, Chile and Mozambique.

HIGH SPECIFICATION SAND—Our service to this field was highlighted by a complete Dorr installation in the Northwest, the solution of a special silica sand problem in California and the equipping of a barge on the East Coast for an entire sand and gravel washing and grading operation.

CHEMICAL PULP—Our score this year was five continuous recausticizing systems for new chemical pulp mills with an aggregate output of 700 tons per day, plus additional equipment for the modernization or expansion of four other mills.

SUGAR—Cane sugar managements have continued the major overhauling of factories neglected since 1930 and in this rehabilitation the use of Dorr Multi-feed Cane Juice Clarifiers and Oliver-Campbell Cane Mud Filters has been conspicuous. Beet sugar manufacturers continue their demand for more Dorr equipment, with the accent on our De-Ionization System.

In England we started up this year a mud disposal plant to utilize, for land-building purposes, the mud washed from sugar beets. We have an order for another for the same purpose in Hawaii.

DE-IONIZATION—Milestones in the rapid progress of D-I have been the successful initial operation of two large units in the sugar and syrup industries and the erection of our first beet sugar pilot plant abroad. In Hawaii, at one plant, D-I is producing an edible sugar syrup, equivalent to an additional recovery of 8,000,000 pounds of sugar per year. Another D-I, at a large beet sugar factory, is expected to increase the sugar extraction 10 percent.

SANITATION—The year saw the first signs of the long-awaited upturn. Our major projects were equipment for San Diego's novel sewage plant; for Oklahoma City's two new sewage plants (one a 25 MGD biofiltration plant, the world's largest); and, for the Sanitary District of Chicago, replacements for 8 special Dorr Clarifiers, now 20 years old and obsolete.

In the water field, large installations of Dorrco Flocculators are being made at Washington, D.C., and Dallas, Texas; while, in active Latin America, we are modernizing one section of the Buenos Aires' water plant at Palermo and equipping that city's Ezeiza Airport with modern biofiltration sewage treatment facilities.

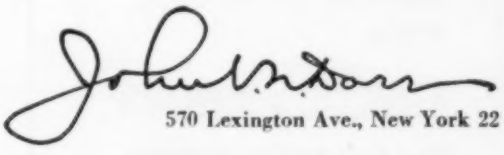
MACHINE DEVELOPMENTS—The year's major machine developments include a new clarifier design; a rapid-mix, externally-heated digester; a heavy-duty hydroseparator with automatic, hydraulic lifting device; a two-stage clarifier and two-stage biological filter; a launder for feeding sedimentation units radially; and a method of controlling the pH of mud in cane juice clarifiers.

* * *

The year has seen much progress with us in quiet ways, with shipments and orders balancing on the largest scale in our history. The successful operation of several important plants in our new fields has emphasized the need of staff additions.

My own journeys included a semi-vacation trip to my "Country of Origin", the Black Hills, with my brother, who last visited there fifty years ago, and a motor trip home via Red Lake and Ontario. Others have carried the major load of travel and report from the Philippines, South America, India, South Africa and Europe a strong will to go ahead and a belief that we shall conquer the threats to world peace that now lie ahead.

To our friends and our associates everywhere, we send New Year's Greetings in a spirit of faith that, while the past year has clarified world problems, 1948 will see the most important steps toward their solution.



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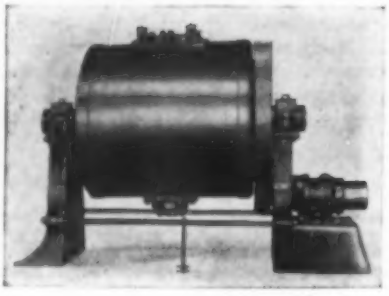
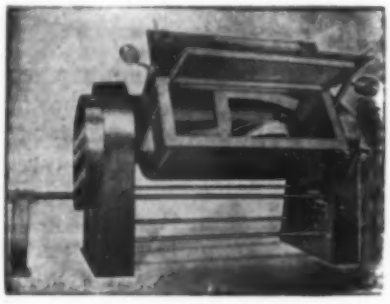
PAUL O. ABBÉ

for



BALL & PEBBLE MILLS

and



MIXERS

Standard equipment in important plants everywhere.

PAUL O. ABBE

The typical machines shown are Ball and Pebble Mill and Mixer.

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United States Production of Certain Chemicals

October 1947, October 1946 and Ten-Month Totals for 1947 and 1946

Chemical (Tons unless otherwise noted)	October 1947	October 1946	Total, Ten Months 1947	Total, Ten Months 1946
Ammonia, synthetic, anhydrous[1]	91,144	80,829	903,351	562,934
Ammonium nitrate, 100 percent	88,249	85,554	868,248	541,403
Ammonium sulphate, synthetic, technical (M lb.)	37,624	35,152	327,237	254,536
Calcium arsenate (M lb.)	2,272	1,916	42,047	33,308
Calcium carbide, commercial	48,336	57,074	504,532	462,996
Calcium phosphate:				
Monobasic (M lb.)	7,343	7,305	58,774	61,000
Dibasic (M lb.)	8,041	5,077	64,724	50,158
Carbon dioxide:				
Liquid and gas (M lb.)	21,307	19,984	210,357	185,782
Solid (M lb.)	58,475	54,906	537,100	557,413
Chlorine	118,662	108,174	1,141,950	955,362
Chrome green, C.P., (M lb.)	1,378	1,210	11,481	15,178
Chrome yellow and orange (C.P.) (M lb.)	4,795	3,168	40,468	36,912
Hydrochloric acid, 100 percent	36,355	32,394	280,722	348,737
Hydrogen (M cu. ft.)	2,030,000	1,561,000	17,571,000	14,501,000
Lead arsenate, acid and basic (M lb.)	.....	2,259	.....	49,078
Molybdate chrome orange (C.P.) (M lb.)	433	435	3,628	4,208
Nitric acid, 100 percent	61,996	61,686	623,673	448,100
Oxygen (M cu. ft.)	1,314,000	1,062,000	11,330,000	9,834,000
Phosphoric acid, 50 percent	99,574	80,673	859,796	732,817
Soda ash:				
Ammonia soda process:				
Total wet and dry[2]	395,609	382,026	3,748,667	3,630,660
Finished light[3]	192,021	188,119	1,817,815	1,715,842
Finished dense	145,846	137,295	1,364,704	1,169,090
Natural[3]	26,328	20,396	231,550	175,048
Sodium bicarbonate, refined	13,892	16,242	161,408	167,376
Sodium bichromate and chromate	8,413	7,066	72,364	83,790
Sodium hydroxide:				
Electrolytic process:				
Liquid[5]	114,753	105,172	1,109,541	938,135
Solid	23,966	19,217	199,353	164,149
Lime soda process:				
Liquid[5]	63,920	63,536	626,590	617,292
Solid	20,460	20,125	204,335	185,070
Sodium phosphate:				
Monobasic	1,195	988	11,893	9,840
Dibasic	6,815	5,253	65,126	48,258
Tribasic	8,187	7,756	73,308	78,721
Meta	2,684	2,239	25,725	21,915
Tetra	5,565	4,789	45,741	45,600
Sodium silicate, anhydrous	43,642	41,188	380,668	343,391
Sodium sulphate:				
Anhydrous, refined	10,335	10,422	113,302	102,223
Glauber's salt[6]	18,462	15,316	164,904	137,122
Salt cake, crude, commercial[4]	51,831	48,367	516,052	440,405
Sulphuric acid:[7]				
Chamber process	267,173	264,277	2,717,149	2,569,584
Contact process, new	574,030	512,733	5,491,492	4,571,034
Zinc yellow (zinc chromate) (C.P.)	252	291	2,708	.....

Data for this tabulation have been taken from "Facts for Industry" series issued by Bureau of the Census. Production figures represent primary production and do not include purchased or transferred materials. Quantities produced by government-owned arsenals, ordnance works, and certain plants operated for the government by private industry are not included. Chemicals manufactured by TVA, however, are included. All tons are 2,000 lb. Where no figures are given data are either confidential or not yet available. [1]Includes a small amount of aqua ammonia. [2]Total wet and dry production, including quantities diverted for manufacture of caustic soda and sodium bicarbonate, and quantities processed to finished light and finished dense. [3]Not including quantities converted to finished dense. [4]Data collected in cooperation with the Bureau of Mines. [5]Figures represent total production of liquid material, including quantities evaporated to solid caustic and reported as such. [6]Includes oleum grades, excludes spent acid. [7]Data for suphuric acid manufactured as a byproduct of smelting operations are included.

United States Production of Certain Organic Chemicals

September 1947, September 1946 and Nine-Month Totals for 1947 and 1946

	September 1947	September 1946	Total, Nine Months 1947	Total, Nine Months 1946
Acetanilid	582,466	.....	5,849,943	.....
Acetic acid:				
Synthetic[1]	26,477,947	21,933,741	275,678,107	203,560,500
Recovered	120,431,594	96,836,421	1,061,732,761	862,947,460
Natural[2]	2,163,722	2,655,615	19,163,703	20,558,677
Acetic anhydride[3]	48,622,319	41,209,257	451,844,182	381,867,269
Acetone	32,063,333	29,120,588	292,063,945	244,884,869

(*Continued on page 320*)

MATERIALS of CONSTRUCTION

for Chemical Engineering Equipment

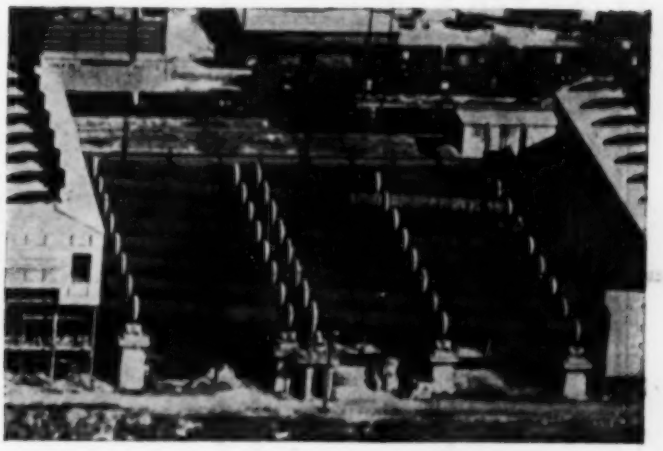
★ Copies of *Chemical Engineering's* Twelfth Report on Materials of Construction are now available. This 96-page booklet gives data on 58 materials used in the process industries. It also includes an article on corrosion problems of the Oak Ridge atomic plant and 8 pages of data and information on gaskets and packings..... **$1**

Editorial Department

CHEMICAL ENGINEERING • 330 West 42nd St., New York 18, N. Y.

Rotary Kilns by the Mile

for a single Traylor customer



The acknowledged leader in production of an essential metal bought and put into operation 43 Traylor Rotary Kilns in less than 3 years. Selection of these Traylor Kilns, whose total length is 10,750 feet, was influenced by the performance and service of other Traylor Kilns which this company has operated for many years.

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ALL-WELDED STEEL SHELLS. The shells of Traylor kilns are made of thick steel plates welded together to obtain single section rigidity. Reinforcing rings strengthen all circumferential joints.

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U. S. Production of Synthetic Organic Chemicals (Cont. from page 318)

	September 1947	September 1946	Total, Nine Months 1947	Total, Nine Months 1946
Acetylsalicylic acid	1,082,728	373,785	10,338,238	7,167,442
Aniline	8,630,160	6,316,897	78,914,389	64,372,921
5-Ethyl-5 phenylbarbituric acid and salts (phenobarbital)	41,597	30,853	337,417	291,878
Benzene:				
Motor grade:				
Tar distillers[4]	.....	572,921	.....	6,977,328
Coke-oven operators[6]	864,087	2,862,437	13,880,186	22,956,029
All other grades:				
Tar distillers[4]	1,240,785	1,423,526	16,397,678	16,051,778
Coke-oven operators[5]	9,792,311	11,246,342	104,391,648	75,017,789
Butyl alcohol primary, normal	10,968,888	13,118,064	97,657,138	87,457,562
Carbon bisulphide	29,543,918	26,457,725	260,054,076	220,537,897
Carbon tetrachloride	15,169,445	13,173,641	148,218,375	105,833,090
Chlorobenzene, mono	27,360,404	21,549,759	242,724,072	193,643,702
Creosote oil:				
Tar distillers[4]	10,217,521	9,948,382	91,307,936	82,698,277
Coke-oven operators[6]	3,189,963	2,765,474	28,497,951	19,001,732
Creosols, meta-para	522,381	804,222	4,626,280	4,384,082
Cresols, ortho-meta-para	547,319	380,909	7,005,317	.....
Cresylic acid, refined[7, 10]	1,696,517	2,455,799	19,392,911	19,549,191
Dibutyl phthalate	1,221,936	.....	15,710,615	.....
Dichlorodiphenyltrichloroethane (DDT)	3,679,269	3,855,842	39,707,989	33,302,459
Ethyl acetate (85%)	6,785,254	7,334,167	62,575,400	67,248,057
Ethylene glycol	18,110,592	.....	157,890,091	.....
Ethyl ether	2,664,300	3,079,223	30,730,158	30,368,527
Formaldehyde (37% by wt.)	41,143,205	36,735,289	389,809,861	337,289,897
Hexachlorocyclohexane	689,582	.....	3,963,603	.....
Methanol, natural[8]	1,329,421	1,220,784	12,014,088	11,718,225
Methanol, synthetic	43,584,214	43,773,153	412,430,445	360,346,319
Naphthalene:				
Tar distillers, less than 79° C.	16,201,827	17,203,040	169,075,128	136,090,019
Tar distillers, 79° C. and over	7,862,695	8,154,983	84,886,872	71,383,059
Coke-oven operators, less than 79° C.	8,009,488	7,537,392	70,832,736	48,832,378
Penicillin and salts[9]	3,365,394	2,214,209	26,638,106	19,098,303
Phenol	23,365,135	13,734,526	194,796,281	142,864,158
Phthalic anhydride	11,799,974	9,333,857	103,186,561	77,838,138
Styrene, government and private plants	22,752,815	30,613,972	224,279,317	280,617,619
Toluene:				
Coke-oven operators	2,363,175	1,472,389	29,673,341	11,972,632
All other[8]	3,294,484	1,270,104	24,722,151	10,377,837
Xylene, crude	2,995,016	.....	.....	.....

All data in pounds except benzene (gal.) creosote oil (gal.), toluene (gal.) xylene (gal.) and penicillin (million Oxford units). Statistics collected and compiled by U. S. Tariff Commission except where noted. Absence of data on production indicates either that returns were unavailable or confidential. [1]Excludes the statistics on recovered acid. [2]Acid produced by direct process from wood and from calcium acetate. [3]All acetic anhydride including that from acetic by vapor-phase process. [4]Product of distillers who use purchased coal tar only or from oil-gas or water-gas produced or purchased by tar distillers. [5]Statistics are given in terms of bulk medicinals only. [6]Statistics collected by Bureau of Mines. [7]Total production including data reported both by coke-oven operators and by distillers of purchased coal tar. [8]Reported to U. S. Bureau of the Census. [9]Includes toluene produced from petroleum by any process. [10]Includes refined cresylic acid from petroleum.

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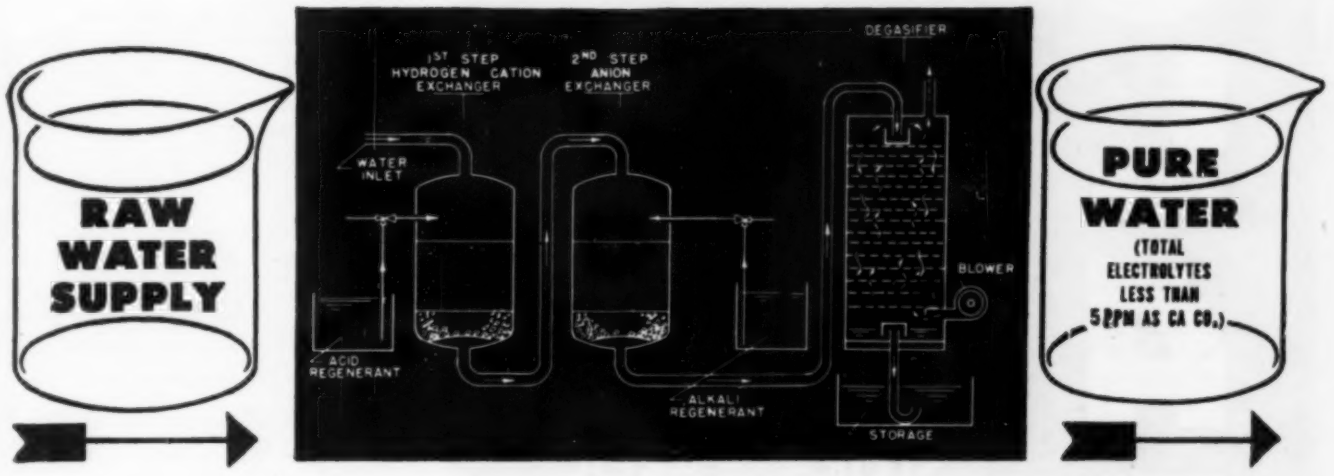

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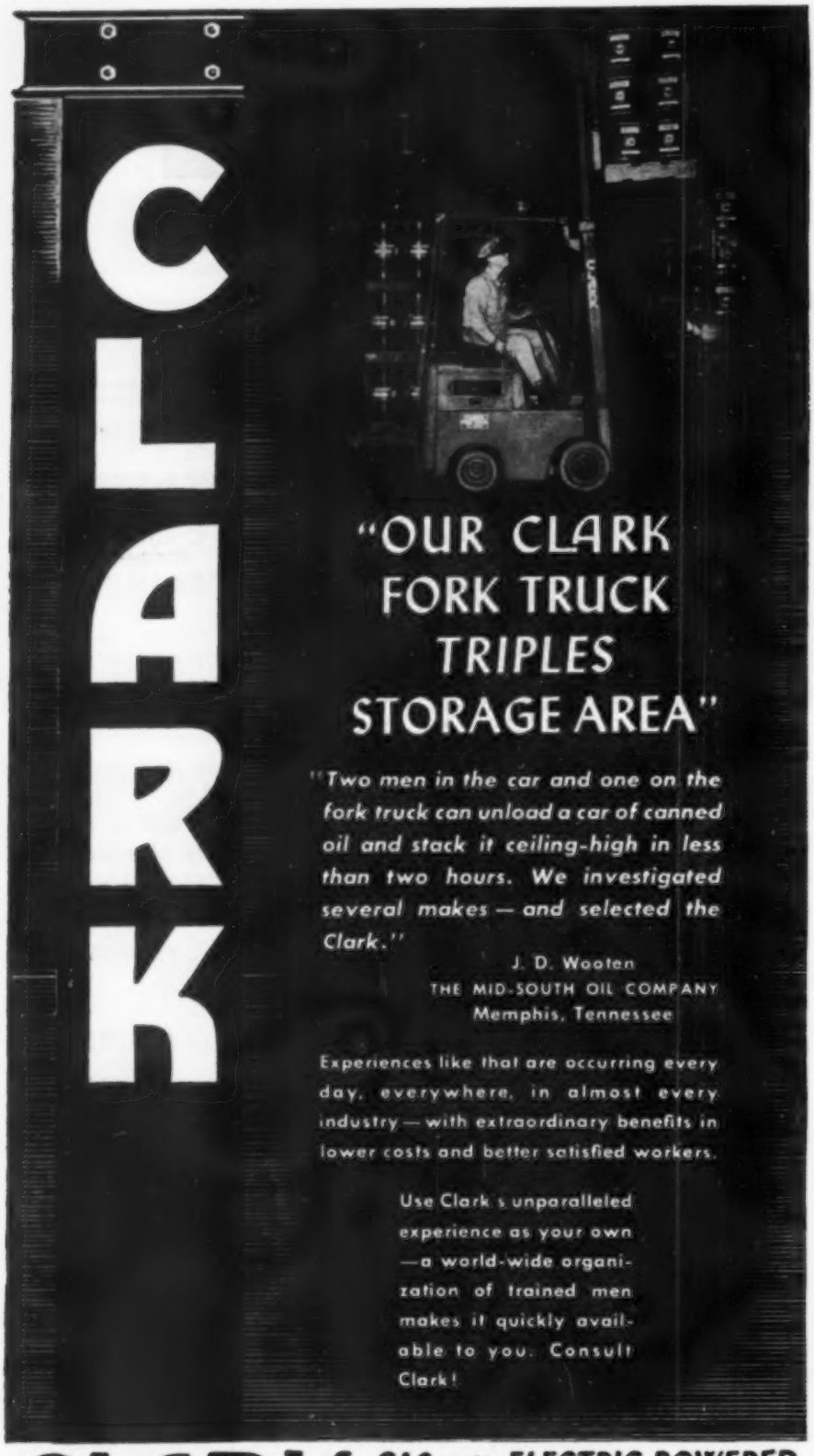
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CHEMICAL ENGINEERING Weighted Index of Prices for CHEMICALS

Base—100 for 1937

As of January 1	127.51
Last month (revised)	128.52
January, 1947	121.63
January, 1946	109.13

CURRENT PRICES

The accompanying prices refer to round lots. Where it is trade custom to sell f.o.b. works, quotations are so designated. Prices are corrected to **January 1.**

INDUSTRIAL CHEMICALS

Acetone, tank, lb.	$0.07½ - $0.09
Acid, acetic, 28%, bbl., 100 lb.	3.78 - 4.03
Boric, bbl., ton	124.00 - 142.50
Citric, drums, lb.	.24 - .26
Formic, cbys., lb.	.12 - .14
Hydrofluoric, 30%, drums, lb.	.08 - .085
Lactic, 44% tech., light, bbl., lb.	.0815- .0855
Muriatic, 18%, tanks, ton	18.00 -
Nitric, 36°, carboys, lb.	.05 - .05½
Oleum, tanks, wks., ton	19.50 - 20.00
Oxalic, crystals, bbl., lb.	.13 - .14
Phosphoric tech., tanks, lb.	.04 -
Sulphuric, 60°, tanks, ton	12.25 -
Tartaric, powd., bbl., lb.	.49½ - .50
Alcohol, amyl from pentane, tanks, lb.	.17 -
Alcohol, butyl, tanks, lb.	.17 - .29
Alcohol, ethyl, denatured, No. 1 special tanks, gal.	.96 -
Alum, ammonia, lump, lb.	.04½
Aluminum sulphate com. bags, 100 lb.	1.15 - 1.25
Ammonia, anhydrous, cyl., lb.	.16 - .20
tanks, ton	59.00 - 61.50
Ammonium carbonate, powd., casks, lb.	.09½ - .10
Sulphate, wks., ton	35.00 - 38.00
Amyl acetate, tech. from pentane, tanks, lb.	.23 -
Aqua ammonia, 26°, drums, lb.	.03 - .03½
tanks, ton	65.00 -
Arsenic, white powd., bbl., lb.	.06½ - .07
Barium carbonate, bags, ton	67.50 - 75.00
Chloride, bags, ton	85.00 - 90.00
Nitrate, casks, lb.	.11½ - .12
Blanc fixe, dry, bags, ton	67.50 - 72.50
Bleaching powder, f.o.b., wks., drums, 100 lb.	3.75 - 4.00
Borax, gran., bags, ton	48.50 - 66.00
Calcium acetate, bags, 100 lb.	3.00 -
Arsenate, dr., lb.	.09½ - .10
Carbide, drums, ton	70.00 -
Chloride, flake, bags, del. ton	21.50 - 38.00
Carbon bisulphide, drums, lb.	.05½ - .06½
Tetrachloride, drums, lb.	.06½ - .07
Chlorine, liquid, tanks, wks., 100 lb.	2.25 - 2.50
Copperas, bgs., f.o.b., wks., ton	17.00 - 18.00
Copper carbonate, bbl., lb.	.24 - .27
Sulphate, bags, 100 lb.	7.60 - 7.75
Cream of tartar, bbl., lb.	.38½ - .40
Diethylene glycol, dr., lb.	.15 - .16
Epsom salt, dom., tech., bbl., 100 lb.	2.30 - 2.60
Ethyl acetate, tanks, lb.	.12 - .16
Formaldehyde, 30%, dr., wks., lb.	.0545-
Furfural, tanks, lb.	.09½ -
Glaubers salt, bag, 100 lb.	1.25 - 1.50
Glycerine, c.p., drums, extra, lb.	.39 - .40
Lead:	
White, basic carbonate, dry, casks, lb.	.16 -
Red, dry, sck., lb.	.176- .18
Lead acetate, white crys., bbl., lb.	.19½ - .20½
Arsenate, powd., bags, lb.	.21½ - .22
Lithopone, bags, lb.	.06 - .06½
Magnesium carb., tech., bags, lb.	.07½ - .08
Methanol, 95%, tanks, gal.	.60 -
Synthetic, tanks, gal.	.24 - .29
Phosphorus, yellow, cases, lb.	.22 - .25
Potassium bichromate, bags, lb.	.11½ - .11¾
Chlorate, powd., lb.	.09 - .09½
Hydroxide (c'stic potash) dr., lb.	.0785- .09½
Muriate, 60%, bags, unit	.37½ - .45½
Nitrate, ref., bbl., lb.	.08½ - .12
Permanganate, drums, lb.	.21½ - .22
Prussiate, yellow, casks, lb.	.19 - .20
Sal ammoniac, white, casks, 100 lb.	4.75 - 5.00
Salsoda, bbl., 100 lb.	1.10 - 1.20
Salt cake, bulk, ton	20.00 - 25.00
Soda ash, light, 58%, contract, bags, 100 lb.	1.30 -
Dense, bags, 100 lb.	1.38 -
Soda, caustic, 76% solid, drums, 100 lb.	2.85 -
Acetate, del., lb.	.05½ - .06
Bicarbonate, bags, 100 lb.	2.25 - 2.75
Bichromate, bags, lb.	.09 - .09½
Bisulphate, bulk, ton	20.00 - 24.00
Bisulphite, bbl., lb.	.03½ - .04

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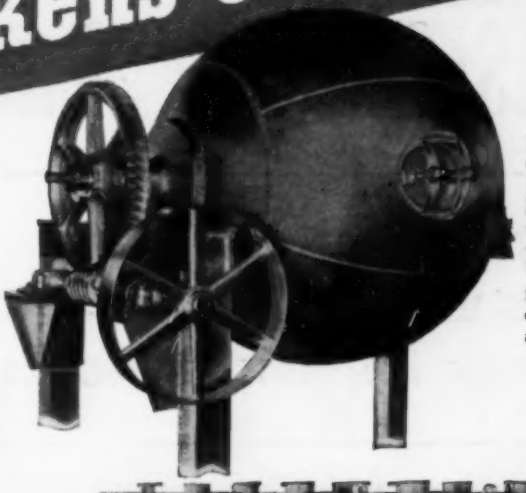
All work under Pressure . . .
ALL use Lukens CLAD Steels



Biggs Boiler Works, Akron, Ohio, selected 5% Lukens Nickel-Clad Steel for this laboratory-type globe rotary digester, 6'0" I.D. It was welded according to U-69 Code specifications, for a working pressure of 200 psi and tested at 400 psi.

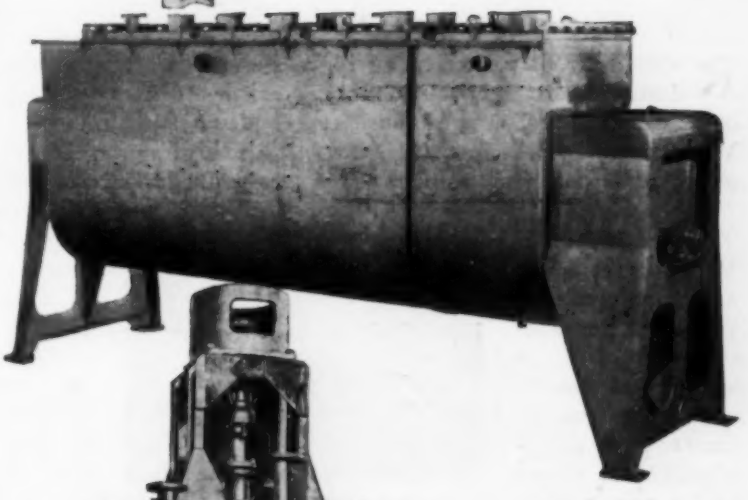
Want to cut your costs of making pressure equipment corrosion-resistant? You can do it with a Lukens Clad Steel.

Corrosion resistance is provided by a cladding of stainless steel, nickel, Inconel or Monel, permanently bonded in a uniform thickness to a backing of any ASME plate specification steel. Structural strength of the composite plate is equal to, or greater than, the tensile of A-285 Grade C steel.

Economy results from use of the corrosion-resistant material in a cladding of from 5 to 50 per cent of total plate thickness. Savings in material costs may be as much as 50 per cent, compared with solid plate of the cladding material.

Fabrication offers no unusual problems. Ordinary commercial methods are used for welding to meet requirements of paragraphs U-68 and U-69 of the ASME Code. No special equipment is needed for bending, shearing, pressing or other forming operations.

For *any* equipment exposed to corrosive processes that are accelerated by heat and pressure, it will pay you to get the facts about Lukens Clad Steels. Information on Lukens Stainless-Clad Steels is contained in Bulletin 338; on Nickel-Clad, Inconel-Clad and Monel-Clad Steels, in Bulletin 255. Lukens Steel Company, 400 Lukens Building, Coatesville, Pennsylvania.



Steam jacketed zinc oxide mixer, fabricated of 20% Lukens Stainless-Clad Steel, type 347, by Lukenweld, Division of Lukens, Coatesville, Pa. Tank and covers are double jacketed for heating at 15 psi.

★

Agitator kettle for chlorinated hydrocarbons, fabricated by Steel and Alloy Tank Co., Newark, N. J., using 20% Lukens Nickel-Clad Steel. Operating pressures are 25 psi at 650 F. in the body; 125 psi in the jacket.

LUKENS

Nickel-Clad Stainless-Clad
Inconel-Clad Monel-Clad
STEELS
★

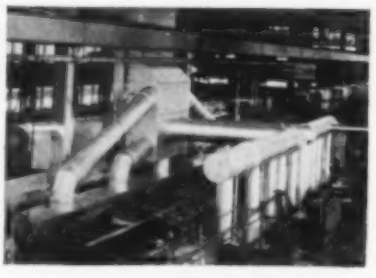
SOLID METAL ADVANTAGES WITH CLAD STEEL ECONOMY

45 INDUSTRIES solve Venting Problems with TRANSITE INDUSTRIAL VENT PIPE

Why plant engineers specify this asbestos-cement pipe for longer life, less maintenance

REPORTS FROM plants in 45 industries indicate more and more engineers rely on Transite Industrial Vent Pipe to carry off corrosive fumes, gases, vapors, dust, and smoke.

The reason is that Transite Industrial Vent Pipe is made of asbestos and cement combined by a special process . . . is strong and durable ...has a high resistance to many corrosive gases, fumes and vapors typical of industrial operations. Plants that formerly had to replace vent pipe at frequent intervals often get years of efficient service from Transite . . . with practically no maintenance costs.



A typical installation of Transite Industrial Vent Pipe venting corrosive gases, vapors and fumes from a large industrial plant.

Because this vent pipe is completely rustproof, it may be used for vents and stacks without protective painting. Light in weight and readily assembled, Transite Industrial Vent Pipe comes in sizes from 3" to 36" in diameter. A full line of Transite fittings assures corrosion resistance throughout the system.

J-M engineers will be glad to consult with you about the use of Transite Industrial Vent Pipe as a possible solution to your venting problems. Ask for Data Sheet series DS-336. It gives full details. Write Johns-Manville, Box 290, New York 16, N. Y.

JM PRODUCTS

Typical industries in which Transite Industrial Vent Pipe is used

Aircraft	Dairy	Gas	Petroleum	Shipbuilding
Automobile	Drug	Glass	Potash	Shoe
Baking	Electrical	Laboratory	Pulp & Paper	Smelting
Bleaching	Explosive	Laundry	Quarrying	Soap
Boiler Works	Farm Machinery	Leather	Railroad	Soft Drink
Brewing	Food	Meat Packing	Rayon	Sugar Refining
Canning	Foundry	Metal	Refrigeration	Textile
Ceramic	Furnace	Mining	Rubber	Tool
Chemical	Furniture	Paint	Sewage Works	Water Works

CHEMICAL ENGINEERING Weighted Index of Prices for OILS & FATS

Base—100 for 1937

As of January 1	293.04
Last month (Revised)	304.66
January, 1947	303.82
January, 1946	145.63

Chlorate, kegs, lb	$0.07½	$0.08
Cyanide, cases, dom., lb	.14½	.15
Fluoride, bbl., lb	.09½	.09¾
Hyposulphite, bags, 100 lb	2.75	3.15
Metasilicate, bbl., 100 lb	3.40	4.00
Nitrate, bulk, ton	37.00	44.50
Nitrite, casks, lb	.06½	.07
Phosphate, tribasic, bags, 100 lb	3.40	4.00
Prussiate, yel., bags, lb	.12	.12½
Silicate, 40°, dr., wks., 100 lb	.95	1.00
Sulphite, crys., bbl., lb	.03	.04
Sulphur, crude at mine, long ton	16.00	18.00
Dioxide, cyl., lb	.085	.09
Dioxide, tanks, lb	.044	.....
Tin crystals, bbl., lb	.60	.....
Zinc chloride, gran., bbl., lb	.07	.07½
Oxide, lead free, bags, lb	.10	.10½
Oxide, 35%, leaded, bags, lb	.11½	.12
Sulphate, bags, cwt	4.15	7.00
OILS AND FATS		
Castor oil, No. 3 dr., lb	$0.27½	.....
Chinawood, oil, tanks, lb	.26	.....
Coconut oil, Ceylon, N. Y., lb	.23	.....
Corn oil, crude, tanks (f.o.b. mill), lb	.31	.....
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.28	.....
Linseed oil, raw, car lots, dr., lb	.333	.....
Palm, casks, lb	nom.	
Peanut oil, crude, tanks (mill), lb.	.29	.....
Rapeseed oil, refined, bbl., lb	nom.	
Soybean, tanks, lb	.26½	.....
Menhaden, light, pressed dr., lb	.25	.....
Crude, tanks (f.o.b. factory), lb.	.22	.....
Grease, yellow, loose, lb	.18½	.....
Oleo stearine, lb	nom.	
Oleo oil, No. 1, lb	.28	.....
Red oil, distilled, bbl., lb	.28	.....
Tallow, extra, loose, lb	.19½	.....
COAL TAR PRODUCTS		
Alpha-naphthol, crude, bbl., lb	$0.64	$0.66
Alpha-naphthylamine, bbl., lb	.35	.36
Aniline oil, drums, lb	.14	.15
Aniline salts, bbl., lb	.22	.24
Benzaldehyde, tech., dr., lb	.45	.50
Benzidine base, bbl., lb	.77	.78
Benzoic acid, USP, kegs, lb	.54	.56
Benzol, 90% tanks, works, gal	.19	.21
Benzyl chloride, tech., dr., lb	.20	.21
Beta, naphthol, tech., drums, lb	.23	.24
Cresol, USP, dr., lb	.14½	.15½
Cresylic acid, dr., wks., gal	1.25	1.30
Diphenyl, bbl., lb	.15	.16
Diethylaniline, dr., lb	.48	.50
Dinitrotoluol, bbl., lb	.18	.19
Dinitrophenyl, bbl., lb	.22	.23
Dip oil, 15%, dr., gal	.23	.25
Diphenylamine, dr., f.o.b. wks., lb.	.25	.....
H acid, bbl., lb	.50	.52
Hydroquinone, bbl., lb	.90	.95
Naphthalene, flake, bbl., lb	.11	.11½
Nitrobenzene, dr., lb	.08½	.09
Para-cresol, bbl., lb	.41	.60
Para-nitroaniline, bbl., lb	.42	.43
Phenol, USP, tanks, lb	.11½	.12
Picric acid, bbl., lb	.30	.32
Pyridine, dr., gal	1.55	1.60
Resorcinol, tech., kegs, lb	.68	.70
Salicylic acid, tech., bbl., lb	.30	.35
Solvent naphtha, w.w., tanks, gal.	.25	.....
Toluidin, bbl., lb	1.00	.....
Toluol, drums, works, gal	.23	.....
Xylol, com., tanks, gal	.25	.....
MISCELLANEOUS		
Casein, tech., bbl., lb	$0.31	$0.32
Dry colors:		
Carbon gas, black (wks.) lb	.04	.07
Prussian blue, bbl., lb	.42	.43
Ultramarine blue, bbl., lb	.13	.24
Chrome green, bbl., lb	.32	.42
Carmine red, tins, lb	5.50	6.00
Para toner, lb	.80	.95
Vermilion, English, bbl., lb	2.50	2.70
Chrome yellow, C. P., bbl., lb	.26	.28
Gum copal, Congo bags, lb	.09	.55
Manila, bags, lb	.09	.15
Damar, Batavia, cases, lb	.10	.22
Kauri, cases, lb	.18	.60
Magnesite, calc., ton	52.75	57.00
Pumice stone, lump, bbl., lb	.05	.07
Rosin, H., 100 lb	9.75	.....
Shellac, orange, fine, bags, lb	.61	.62
Bleached, bonedry, bags, lb	.63	.64
T. N. bags, lb	.59	.60
Turpentine, gal	.76	.....

MECHANICAL FAILURE

With the LaBour Type Q, mechanical failure is impossible because there is only one moving part, the impeller. No downtime ever, to repair or adjust valves, links, springs or other unnecessary parts.

WEAR OR CORROSION

Because the LaBour Type Q has an open impeller, efficiency does not depend on close clearances; only extreme wear or corrosion can affect performance significantly. Frequent periodic examinations are unnecessary—impellers need be replaced only after long, hard service.

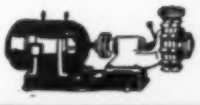
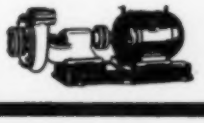
AIR BINDING

Accidental gulps of air or vapor don't stop the Type Q. This centrifugal pump, though not classed as self-priming, can handle about 20% air or vapor mixed with liquid for an extensive period, or can dispose of brief 100% gulps—with no attention from maintenance men.

AVOID

these causes of pump downtime with the LABOUR type "Q"

A quick look at the exploded view illustrated above will show you the extreme simplicity of construction of the Type Q. That's your assurance of long, trouble-free service—with an absolute minimum of costly pump downtime. Write us for more facts on the LaBour Type Q, or on self-priming units, to solve any chemical liquid pumping problems.

LaBour

CENTRIFUGAL PUMPS

THE LABOUR COMPANY, Inc. • ELKHART, INDIANA, U.S.A.

NEW CONSTRUCTION

	Current Projects		Cumulative 1947	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	$55,000	$9,016,000	$2,919,000
Middle Atlantic	$2,205,000	168,000	13,247,000	37,364,000
South	600,000	2,099,000	23,433,000	53,835,000
Middle West	5,650,000	143,000	22,472,000	23,859,000
West of Mississippi	2,310,000	6,572,000	304,977,000	147,364,000
Far West	123,000	5,150,000	5,529,000	27,203,000
Canada	1,100,000	.....	42,412,000	50,385,000
Total	$11,988,000	$14,187,000	$421,086,000	$342,929,000

Proposed Work

Ark., North Little Rock—Linde Air Products Co., c/o Union Carbide & Carbon Corp., 30 East 42nd St., New York, N. Y., plans to construct a plant for the manufacture of oxygen and acetylene. Estimated cost $250,000.

Calif., Bakersfield—Royal Tallow & Soap Co., 1260 Davidson St., San Francisco, plans to construct a 2 story tallow rendering plant. Estimated cost will exceed $55,000.

Calif., Los Angeles—Pacific Guano Co., 4522 Worth St., plans to construct a factory. Henry S. Howard, 2nd St. and Hearst Ave., Berkeley, Archt. Estimated cost will exceed $68,000.

Colo., Denver—Gates Rubber Co., 999 South Broadway, plans to construct a 4 story concrete warehouse. Estimated cost between $1,000,000 and $1,500,000.

Ga., Atlanta—Atlanta Paper Co., 225 Monroe St., S. E., plans to construct a paper plant. Estimated cost $500,000.

Ill., Collinsville—Illinois Farm Supply Co., c/o Illinois Agricultural Assn., 608 South Dearborn St., Chicago, Ill., plans to construct a 50,000 ton capacity per year fertilizer plant here. Estimated cost including equipment $1,150,000.

Ill., Monsanto—Monsanto Chemical Co., 1700 South Second St., St. Louis, Mo., plans to construct additions to its chemical plant here. Estimated cost $1,500,000.

Ky., Somerset—International Minerals & Chemical Corp., 700 Vine St., Louisville, Ky., plans to construct a fertilizer plant here. Estimated cost $100,000.

N. J., Elizabeth—Interchemical Corp., Empire State Bldg., New York, N. Y., plans to construct a factory for the manufacture of printers inks. Estimated cost $2,000,000.

O., South Euclid—Pesco Products Co., Cleveland, is having plans prepared by McGeorge & Hargett, Archts., 9400 Quincy St., Cleveland, for experimental laboratories, factory and office buildings. Estimated cost $3,000,000.

Pa., North Wales—Sharpe & Dohme, 640 North Broad St., Philadelphia, Pa., plans to construct a pharmaceutical building here. Estimated cost will exceed $205,000.

Tex., Galveston—Pittsburgh Plate Glass Co., 2309 11 Ave., plans to improve and enlarge its glass shop. Estimated cost $60,000.

Tex., Houston—Jas. Bute Co., 1301 McKinney St., plans to construct a paint manufacturing plant. Estimated cost $525,000.

Tex., Houston—Gulf Oil Corp., Box 2100, plans to construct a laboratory. Estimated cost $225,000.

Alta., East Calgary—McColl-Frontenac, Ltd., Notre Dame St., E., Montreal East, Que., Can., plans to construct an oil refinery here. Estimated cost $1,000,000.

Ont., Leaside—Standard Chemical Co., Ltd., 195 Fleet St., E., Toronto, plans to alter its plant. Estimated cost $100,000.

Contracts Awarded

Ala., Anniston—Monsanto Chemical Co., Anniston, has awarded the contract for the construction of a service building to Andrew, Dawson & Shenesey, Anniston. Estimated cost $100,000.

Fla., Miami—Standard Oil Co., 61 N.W. 11th St., has awarded the contract for the construction of a warehouse and storage shed to Hillyer & Loyan, P. O. Box 371, Jacksonville, at $173,500.

Fla., Orlando—Atlantic Chemical Co., Orlando, has awarded the contract for the construction of a warehouse to W. A. McCree, Jr., Orlando. Estimated cost $75,000.

Md., Baltimore—American Oil Co., American Bldg., has awarded the contract for an engine testing laboratory to Lacchi Construction Co., 2023 Maryland Ave. Estimated cost $100,000.

Mass., Taunton—Geilich Tanning Co., West Water St., has awarded the contract for a tanning plant to Walter Barker, Inc., 23 Main St., Taunton. Estimated cost $55,000.

Mich., Detroit—Michigan Consolidated Gas Co., 415 Clifford St., has awarded the contract for a pump house to C. E. Tackels, 835 Book Bldg. Estimated cost $75,000.

N. J., Perth Amboy—Witco Chemical Co., 295 Madison Ave., New York, N. Y., has awarded the contract for design and construction of an asphalt processing plant, including laboratory, warehouse, loading platform, etc. on 40 acre site to Wigton-Abbott Corp., 1225 South Ave., Plainfield.

N. C., Asheboro—National Carbon Co., Asheboro, has awarded the contract for a plant addition to S. E. Trogdon, Asheboro. Estimated cost $100,000.

N. C., Greensboro—Southern Oxygen Co., c/o R. B. Swope, Pres., will construct an oxygen plant here. Work will be done with own forces. Estimated cost $75,000.

N. C., Roanoke Rapids—Halifax Paper Co., Roanoke Rapids, has awarded the contract for an addition to its plant to C. M. Guest & Sons, Greensboro. Estimated cost $1,150,000.

Tenn., Nashville—Pittsburgh Plate Glass Co., c/o Sumner Construction Co., contractor, 151½ 4th Ave. N., Nashville, will construct a warehouse. Estimated cost $75,000.

Tex., Beaumont—Magnolia Petroleum Co., Beaumont, will construct an addition to its refinery consisting of two-stage crude distillation units. Work will be done with own forces. Estimated cost $1,329,000.

Tex., Big Lake—Witco Hydrocarbon Corp., c/o Fish Engineering Corp., M & M Bldg., Houston, Tex., has awarded the contract for a natural gasoline plant and carbon black plant in Barnhart Field, to Fish Engineering Corp. Estimated cost $3,800,000.

Tex., Carthage—Glassell & Glassell, Commercial National Bank Bldg., Shreveport, La., will construct a gasoline plant. Work will be done with own forces. Estimated cost $1,250,000.

Tex., Houston—Gulf Chemical Co., Galena Park, has awarded the contract for a warehouse, Unit No. 1, to R. P. Farnsworth & Co., Inc., Bankers Bldg., Houston, at $78,426.

Tex., Houston—F. H. Maloney Co., 410 Bastrop St., has awarded the contract for a plastics plant to Marxon & Son, 1921 Westheimer St., Houston. Estimated cost $115,000.

Utah, Salt Lake City—Standard Oil Co. of California, 225 Bush St., San Francisco, Calif., has awarded the contract for a refinery to Bechtel Corp., 220 Montgomery St., San Francisco. Estimated cost $5,000,000.

Wash., Kalama—Columbia Veneer Corp., Kalama, has awarded the contract for a plywood and veneer mill to E. W. Knokey, Kalama. Estimated cost $150,000.

Wis., New Holstein—Arps Corp., New Holstein, will construct a 1 story, 45x96 ft. paint shop and warehouse and 1 story, 70x97 ft. welding shop. Work will be done by owner.